JOINT STAFF WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

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In the Matter of:               )
                                )  Docket No.
CALIFORNIA STRATEGY TO REDUCE   )  01-SRPD-1
PETROLEUM DEPENDENCE            )
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Reported by:
Valorie Phillips
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CEC STAFF PRESENT

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Dave Smith, British Petroleum

Ruth McDougal, Sacramento Municipal Utility District

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P R O C E E D I N G S

9:08 a.m.

MS. BROWN: It is my great pleasure to now introduce Commissioner Michal Moore, who is one of the members of the Fuels and Transportation Committee who will be responsible for overseeing this report. Thank you, Michal.

PRESIDING MEMBER MOORE: Thank you, Susan. And thank you, all, for being here. Obviously very troubling times and ones which underscore the relationship and the interdependence that we have on energy supplies from all over the world.

So, I'm here on behalf of the Committee and on behalf of my own fellow Commissioners, to welcome you to the Commission, and to welcome my very distinguished colleague, Alan Lloyd, who will join us today for collecting your input on California's strategy for reducing petroleum dependence.

Assembly Bill 2076 directed the Energy Commission and the Air Resources Board to develop and submit to the Legislature a strategy to reduce petroleum dependence in California which is due by January 31, 2002. And unlike some people we know, we feel bound by and honor the time commitments that we have for getting products out. And I assure you that that product will be delivered on time.

We've asked you here today to provide expert advice to the Commission and to the Air Resources Board on strategies that we can develop, techniques that we can use, information that we'll need to reduce our reliance on petroleum-based fuels which is, as you know, nearly 100 percent of our transportation energy.

Obviously the workshop is well timed considering some of the immense challenges that we're going to face trying to maintain or even alter our way of life, and certainly the design of our systems.

We're forecasting that California's demand for petroleum fuels will grow at 2 percent per year over the next 20 years. That's a significant number, and one which offers significant challenges, as well.

It's influenced by population growth; growth in the state economy; the total number of vehicle miles traveled; and consumer preferences. Aided, no doubt, by some of the ad campaigns that they see for larger and less fuel efficient vehicles.

It's also inexorably stamped by the designs that we continue to insist upon in terms of decentralized housing and the kinds of settlements that we develop. Our absolute insistence legislatively, and perhaps just publicly, against public transportation; against transportation systems that might alter our reliance on vehicles. And that's, I guess, our own human tragedy.

But we can change that. And we can diminish in the course of that some of the reliance that we have on petroleum and the associated environmental costs, the knock-on costs that come with it.

So, we have other challenges that we want to ask you to comment on. Our reliance on short refinery capacity is an issue, as is the fact that we haven't sited a new refinery in the state in many many years. And have basically guaranteed through the structure that we've set up at the local government level that there will not be any new refineries sited in the state. And we need to ask ourselves whether or not that's the right strategy to maintain.

We have unexpected supply disruptions that will be causing us to think about how to overcome them, how to overcome storage difficulties. How to deal with the phase-out of MTBE and the phase-in of ethanol in a timely way as a substitute. And the logistical and distribution problems that that brings with it.

So, at some point every one of us knows that there will be a real decline in availability of petroleum products, and the challenge is to anticipate that and build up a diversity of capacity and responsibility that can overcome that in the future.

So, what I'd like to do is to stress that we're looking for as many diverse and open ideas as we can get today. And we welcome your testimony, we welcome your remarks. And ask you to understand that this is now going to become a continuing, rather than a point, dialogue.

And that we'll be engaging you on a continuous basis to define and redefine these objectives so that we can be as dynamic as the market is undoubtedly going to prove to be in the future.

So, with that let me turn to Dr. Lloyd and ask him for his comments. Welcome.

CHAIRMAN LLOYD: Thank you very much, Dr. Moore. On behalf of the California Air Resources Board I am pleased to join, as I mentioned, Commissioner Moore and the staff of both our agencies for what I think is a very important dialogue today and continuing. Also like to recognize Dr. Art Rosenfeld, another Commissioner here. I don't know whether there are any others, but I think the -- and Steve Larson, I think, and the staff at CEC.

I particularly appreciate the working relationship we have with the CEC. I think it's from the top down. We don't always agree, but on the other hand we have frank and forthright exchange of information.

I think clearly the events of this last week on this particular issue makes it all the more incumbent upon all of us to address this critical relationship between energy, air quality and petroleum independence as affecting California.

As you know this year's focused on the electricity market, the electricity crisis and the fundamental questions related to that. It's very important we address the transportation sector here, and to put this on as sound a footing as possible.

I think most of our conventional air pollution problems are rooted in our dependence on petroleum fuels. And you don't have to go back very long to look at this article in The Los Angeles Times on the 17th of August that basically says fossil fuel cuts would reduce early deaths, illness study shows.

One can quarrel about maybe some of the details here, but I think it's very important to recognize that. Again, I'm not, in this case, looking at particularly picking on the petroleum industry, because one, I think the things we've seen particularly, as I've served on the California Fuels Partnership over the last several years is that these are true energy companies.

When I was in London last week attending a fuel cell conference it was very clear that the major oil companies are now truly energy companies. They also recognize that we need to transition into fuels which, in fact, don't have carbon, ultimately. And that that in turn will lead to significant benefits for public health.

I think if we look at conventional air pollutants it's ozone and PM2.5. Not only PM2.5, but in fact, getting down as low as .1 or .01, and that's going to be impacting from a lot of the combustion technology. Toxic pollutants such as benzene, diesel, particulate, we know a lot about. And again, more and more we hear about the localized impact, whether it's from landfills, or in this particular case for petroleum, around refineries.

Global climate change, an increasing spectre on the horizon here. An issue of economic competitiveness. Reliability of our personal mobility. And obviously, the national security of the U.S. And I think events of the last week, as Dr. Moore, Commissioner Moore has mentioned, I think this even heightens the importance of what we're trying to do here. Because, as we can see, is playing out across a much bigger spectrum. But a lot of this points to, in fact, the dependence of oil in the Middle East.

I think, as Commissioner Moore mentioned, too, our task in California is complicated by the phase-out of MTBE. Without a waiver we have significant challenges to get enough ethanol into the mix here. And I think how do we transport that ethanol here? Where do we get it? At what price? At what impact to the consumer?

That's in addition to some of the challenges from ethanol as it affects air quality and volatility, et cetera.

I think we have a confluence of factors here which means that I think public policies need to be examined, and take all those various considerations into account. It's very clear that 100 percent petroleum dependence is not inevitable. In fact, now more than ever we need to say that we need to start on a road where that energy diversity is critical.

As I said before, the energy companies are recognizing this. We need, as public officials, to work with them to make sure that happens.

So I think additional policies to transfer niche markets currently for hybrids, fuel cells, alternative fuel vehicles, need to be encouraged so that in fact these, over a period of time, in fact get a large share of the market.

I now many of you in the audience are working on some of these technologies, and I say I think, speaking on some of the technologies side, it's wonderful to see all the progress being made. I see many representatives from the auto industry. I see Ben Knight, one of my colleagues from Honda, here. Their contributions, I think, are significant. And they're working very hard to in fact try to diversify the technology, get more fuel efficient vehicles out there.

I think again, we need, however, to make this into a reality. So right across the transportation sector, both on-road and off-road, we look, in fact, to make more use of energy diversity, more fuel diversity there, and this energy independence.

Looking at the program I'm very impressed with the high caliber of the speakers invited to the workshop, and look forward to their remarks. And I'm sure the contributions will add to the quality of the final report to Governor Davis and the Legislature.

And again, I can't over-emphasize the importance I personally attach to this project. The events of last week, just to me, put the icing on the cake. I've said for some time we need to show the way in California, and I think we can do a particularly good job.

I'd like to thank you all for taking time out of your busy schedule today. I would like to single out Paul Wuebben, a Clean Officer with the South Coast Air Quality Management District, who, courtesy of Dr. Barry Wallerstein, has actually spent about a day a week, at least officially, I know Paul's spent many more time than that, to work with the Air Resources Board because of his knowledge on this topic. And I think ha helped both the Energy Commission Staff and the Air Resources Board Staff on that particular aspect.

So, with that, Commissioner Moore, thank you very much for inviting me here today.

COMMISSIONER MOORE: Thank you very much. And, Susan, I'll turn back to you for the schedule.

MS. BROWN: Yes, I have a staff presentation which I'm going to make, and then I'll ask Paul Wuebben to make one on behalf of the Air Resources Board.

Before I do that, however, I do want to

recognize a few more people in the audience. Not to embarrass you, but I want people to know who you are. Thank you, again, Commissioner Rosenfeld, for joining us. Next to him is John Wilson, his Advisor. Art, you don't want to --

(Laughter.)

MS. BROWN: Susan Bakker is here, who is the Advisor to Commissioner Moore. Mike Smith, who is the Advisor to Commissioner Keese. And in the back of the room Nancy Deller, the Deputy Director for Transportation Energy, and my boss.

So, thank you all for coming. We have a few -- no, we don't. I'm going to give a brief overview presentation, giving a sense of what the scope of this report will be.

We've already talked about Assembly Bill 2076, which was signed by the Governor, requiring the joint report by the Air Resources Board and the Energy Commission by January 31, 2002.

The legislation has actually three parts. It calls for a recommended strategy for reducing petroleum dependency, a forecast of gasoline, diesel and petroleum consumption for both 2010 and 2020. And statewide goals for reducing the rate of petroleum growth.

We believe that the intent of the legislation is really threefold. First, to address the issue of fuel price volatility, rising petroleum demand and limits on the state's refining capacity. Commissioner Moore has already mentioned that we're projecting a 2 percent demand growth in petroleum fuels, which represents 40 percent by 2020, at a time when our state's refining capacity is limited.

The bill calls for recommended strategies, specifically increased transportation energy efficiency, the use of nonpetroleum fuels and the use of advanced transportation technologies.

There's another provision in the bill that asks the Commission to evaluate the feasibility of petroleum product reserves, which is actually being addressed in a separate study in a separate proceeding.

If you'll notice, the agenda for today's workshop is basically organized around these four general areas of concern: The first, transportation energy efficiency measures. Can take the form of standards, incentives, public outreach programs, and a number of other approaches. We're going to talk about that issue in panel number one.

The second panel will address advanced vehicle technologies. Again, the legislation specifically requires that we make recommendations on alternative fuel vehicles, hybrid vehicles and high efficiency gasoline vehicles.

Nonpetroleum fuels will also be addressed in panel three. And panel four will address consumer demand measures.

So these are some of the general questions that we're going to pose, ask for input on today. First, what is the technical and economic potential for improving vehicle fuel economy.

This is a much-debated issue before the Congress, as we speak. Very recently the National Academy of Sciences has released a report with its recommendations on corporate average fuel economy standards. As I mentioned before, that will be the subject of our second panel.

The other question is how soon can we have advanced technology vehicles in large commercial volumes, such as hybrids, hybrid electric, fuel cells and how can these vehicles substantially reduce fuel use for petroleum.

And lastly, what other measures such as fuel efficient tires, aerodynamic design, new engine technologies and lighter weight materials, how do these measures affect transportation, energy efficiency and fuel economy.

The second category of issues has to do with the use of nonpetroleum and alternative fuels. We are looking both at substitutes for diesel and gasoline.

As you know, diesel fuel will become cleaner as federal specs will require up to 15 percent sulfur in the fuel. There are a number of emerging fuels such as -- diesel, gas-to-liquids, biodiesel, oxydiesel and other fuels that can be used to displace diesel, either as a blending agent or a direct fuel substitute.

How soon can these fuels enter the market, and how soon can fuels like liquified natural gas enter the marketplace to replace diesel in heavy duty vehicles. These are some of the questions that we'll be addressing today.

And lastly, to what extent can natural gas, propane, electric and ethanol replace gasoline, either dedicated vehicles or niche markets.

Pricing strategies are one of the measures that were evaluated in great detail in 1994 and 1995 by both the Commission and the ARB. We don't plan to repeat that analysis, but simply update it slightly. And we do realize that pricing strategies, while maybe not popular, are very effective in reducing driving and reducing vehicle miles traveled. And those measures, if adopted, can have a significant effect on fuel use.

Direct financial and monetary incentives are being evaluated, as well. There was state legislation passed about a year ago that provides carpooling access for alternative fuel vehicles. And we've heard from Honda that in areas like the Bay Area and in parts of Los Angeles that carpool lane access has actually increased the sales of natural gas vehicles.

And in the third area, land use and smart growth strategies are a fundamental issue which we'd like to address in this report. One of the emerging concepts is the issue of land location efficient mortgages. How can you site transit in heavily dense population areas to encourage people to get out of their cars and use public transportation.

This is just one of the many examples of what we're calling smart growth strategies that should be pursued.

And lastly, other measures such as telecommuting, speed limit enforcement, ridesharing and shared cars will be evaluated.

Our staff analysis is using a cost benefit framework to rank measures based on their impact on vehicle miles traveled, emissions, energy use reductions. However, we realize that many of the measures we're talking about today don't lend themselves well to cost benefit analysis. But we will be using a combination of quantitative and qualitative analysis to arrive at results.

We've hired A.D. Little -- and Mike Jackson is here to present, soon after me -- to evaluate the effectiveness of past strategies to displace petroleum, including technology advancement strategies.

And lastly, consultant studies are underway in a number of topics including vehicle fuel economy, hybrid and fuel cell potential, land use and liquified natural gas potential and costs.

One of the issues that is probably the most difficult for us is trying to figure out what measurable statewide goals can be recommended. The legislation specifically asks for both short-term, mid-term and long-term goals. But one of the issues we'd like to have debated today and have input on specifically is what kind of measurable goals could the state recommend to reduce the rate of petroleum growth.

Lastly, in terms of where we are, we are completing a number of staff analyses and consultant work during the month of September. And our hope is to get not only oral comments today, but a number of written comments on what recommended goals and strategies are not only possible, but that you would recommend.

There will be a staff draft report. I have set probably an ambitious target of October 15th for that. We're going to shoot for that and hope to make it. This is, however, a very optimal schedule. And then at some point we will entertain a joint hearing with the Air Board to adopt and discuss these recommendations.

So, again, I want to thank you all for

your attention and hope to have a very lively discussion and debate of all of these issues today.

At this point I think I'd like to call Paul Wuebben.

MR. WUEBBEN: Good morning. It's certainly a pleasure to be here. I thought I might first start with a general observation that was done five years ago in receiving the Charles Percy Award when Chuck Imbrecht noted that energy, environment and economy are the three linked E's. And I think that that's certainly what we confront today.

I was asked to give a perspective on air quality in order to provide the context of some of the discussions and developments of strategies for this effort. I think one of the first key issues obviously is what have been the trends in air quality and background. Also talk about the transportation sector and what their emissions characteristics are. Some of the health effects and welfare effects associated with that.

And I think also the core issues that underline some of which are what are the implications of some of that, those air quality issues in terms of well-to-wheels, overall efficiency, what are the mass commercialization opportunities for advanced technologies and alternative fuels. And specifically what kinds of displacement opportunities exist for alternative fuels.

I think it's important initially to put in context that each year the world's population grows 100 million. As AMOCO noted just several weeks ago in an op-ed, 50 percent of the project 2010 world global petroleum demand is currently not in production. And I think there also are some other fundamentals about the thickness of our atmosphere, the amount of CO2 growth, the length of time it took to develop petroleum compared the depletion time.

Some of the critical challenges, I think, as relate to petroleum dependence have been identified through the energy efficiency as a core challenge, accelerating the commercialization of hybrids and other advanced technologies; and of course, diversification of our system.

Fundamentally we should ask what are the vulnerabilities. The vulnerabilities, as Dr. Lloyd mentioned, include a host of air quality challenges; global climate change risk; the efficiency of our energy use; the actual total supply; the volatility of the price structure; the recessionary pressures that underscore that; regional mobility, of course; land use efficiency that we'll hear about in the next day and a half; water quality, and of course, geopolitical strategic issues.

Now at the South Coast Air District, of course, we are confronted with perhaps the greatest air quality challenge nationally, although we've had some competition over the years in Houston and other areas, but just as a benchmark that's an area with 15 million people, 10 million people, 60,000 permits for stationary sources, seven major refineries.

We have seen, from our -- that there's been a real improvement in the peak ozone levels. You see in this slide, say back from 1988 through the year 2000 we made fairly steady progress in the peak ozone levels. And we've also done that despite the fact that the VMT and population have both grown during the last 20, in fact several, three or four decades.

The current count, if you will, for

ozone this year, if you want to compare it to Houston or even the San Joaquin Valley, that we've had 29 days so far this year through the 23rd of August, in excess of the one-hour ozone standards, with a peak of just over 18 pphm.

Of course, the number of stage one days, I think, are showing an even more dramatic improvement. And we should all take great pride at the state level and at the local level for bringing that kind of a pack of improvement despite population pressures.

As we look at the concentration of ozone you can see that it's moved significantly to the east, if you will. And now the peak levels are actually up in some of the mountain areas, just below that.

Now, there has been, in fact, less progress with respect to respirable particulate, both PM10 and PM2.5. The number of days, for example, that exceeded the state standard is still well over 250 days a year. There has been a concentration of PM10, as well, but for PM2.5 we even have a broader distribution. Of course, these are where the mobile sources, as you may know, diesel, for example, virtually 99 percent or more of diesel particulate is less than 1 micron. So certainly reflected significantly in these charts.

Another point Dr. Lloyd mentioned, benzene, as an example of the air toxic exposure. The trends of benzene have been, we think, very dramatic. And in large part due to the bringing on of obviously reformulated gasoline at the state level.

Now, what are the respiratory implications? Obviously, acute and chronic symptoms associated directly with ozone and particulate matter. Cancer risk clearly associated in hundreds of studies from a variety of compounds, particularly diesel and the aromatic hydrocarbons associated with petroleum use. And, of course, the youth and elderly are especially susceptible.

Another interesting context, you'll note that the continuing studies point to the linkage between ozone exposure impact delayed lung growth, particularly in the children.

We, of course, have seen some reduction in cancer risk statewide, which I think definitely shows we're moving in the right direction.

However, there continues to be 70 percent of the ambient cancer risk in the South Coast Air Basin associated with diesel.

Here's an example of what the cancer risk would be if we did not include diesel exposure. And that graph shows what would happen if you, in fact, take account of it. And I think that's quite a dramatic indication of that.

Of course, there have been continuing reports about the importance of low level exposure to very fine respirable particulate, as noted in the American Heart Association Journal just several months ago, can, in fact, increase the risk of heart attack in the short term.

Now, there are very significant sources of ROG and NOx that, of course, do consume petroleum products. It shows cars, industrial and boats, for example, as significant gasoline sources. Of course, the diesel segment is significant there, as well.

There has been some real improvement in the passenger car efficiency progress, that there is significant. The slide shows there's been almost a 99 percent improvement, if you compare it to noncontrolled levels.

But at the same time we certainly need to focus not just on passenger cars, but also on the heavy duty truck sector. It shows that with the projected standards that will take place in 2007 that there will be, perhaps, 98 percent reduction compared to no controls.

We still have issues that should get to that, and here you can see the significance of vehicles and ROG and NOx. And on another issue, I think that's crucial to try to place these emission questions in context, is how do various advanced vehicles compare with respect to NMOG emissions, for example. Here we see both indirect and direct emissions taken into account. And we're very excited to see the continuing acceleration of a partial ZEV, the super ULEV category, the BEVs coming on because of their much greater lower emission characteristics.

If you look at air toxics, a similar pattern of things; namely that the SULEV and partial ZEV technologies are much cleaner than even all of year 2002 conventional vehicles.

In terms of carbon dioxide, there's a similar story. But I think a much more difficult challenge, if you will, to try to obtain the maximum efficiency benefits from all of these. But at the same point, you'll notice that the gasoline ICE engine is pretty much the highest consumption at this point.

There's another perspective might be if you took a zero emission vehicle, for example a convention or battery/electric and even accounted for the electricity production, over 100,000 miles that the emissions associated with that operation would be less than the LEV gross polluter in a two-week period. And that's looking at both hydrocarbons and NOx.

Now, the advance of the hybrid technology offers a tremendous opportunity to make some very accelerated gains in the near term. And I'd just point out an obvious example that we all know of in recent -- what I think we find most compelling is that there's a fairly significant portion of driving cycles that, in fact, can operate without any ICE operation, even with these hybrids.

Again, we see, relative to a gasoline engine as a baseline, hybrids offering perhaps 50 percent improvement. EVs even lower than that, depending on what their fuel mix is. And fuel cells even cleaner than that.

And one of the important opportunities therefore technologically is to take advantage of the high efficiency in low torque of an electric engine compared to the high efficiency at higher engine speeds of conventional technology.

And that's why, I think, what we're trying to do in looking at the technology, as well as the emission trends, is to build an idea of building markets for these alternatives built on an understanding of convenience, infrastructure, price. How all of that can be structured in a sustainable fashion.

We also think getting public information is extremely important to the public. Once they find the incentives, for example, carpool access, and even just understanding that there are cleaner vehicles out there. And as you may know, our Board, the South Coast Air Board, has recently enacted a campaign to identify clean air choices in association with the L.A. New Car Dealers Association.

There's been, I think, a very impressive list of recent announcements. I think we've all known about the recent Prius, what, 60,000 worldwide. There's been some exciting developments at Ford. Honda has recently announced an additional -- and, of course, GM and Chrysler with the Dodge Durango. So those are important technologies. As they come on I think we're all aware of some of these. The latest fuel cell NECAR 5 that's a demonstration, or at least in prototype.

The No Emission, zero emission bus, which will be very important in the near term, for commercialization. The natural gas engines have accelerated dramatically, particularly in response to fleet rules in the South Coast.

And so as we then look to the future I think that we can really say that zero emissions are the core of the strategy and zero technology. That we can get new cars even cleaner than they are today, as well as trucks.

We need to integrate -- cleanest fuels possible, utilize very durable efficient traps and catalysts, and accelerate the replacement of older vehicles, along with expediting efficiency.

So, as we look to the future we look at advancing our investments in both infrastructure and R&D that is very well leveraged. And that

California has obviously led by example.

So obviously in the alternative fuels we're looking at battery/electric, natural gas and transit, and well beyond that in other fleets and larger vehicles. Fuel cell roadmap will provide a very important indication of how to structure our investments there.

And, of course, there's a whole slew of additional efficiency improvements to be made.

So I think that as we summarize, we look at the next 10, 20, 30 years, it will clearly be essential that we continue to improve and introduce zero emission technology. That we reduce emissions of the existing fleet through fleet rules and other mechanisms. And that we find unknown emissions where we can.

And particularly to start to institutionalize in California efficiency in transportation. And to start to prepare for this transition.

So, I appreciate the opportunities, and perhaps we can all find some inspiration by Eleanor Roosevelt who noted that we need to do what we think we cannot do.

Thank you very much.

(Applause.)

MS. BROWN: Thank you very much, Paul. While Mike Jackson is setting up I also want to recognize Catherine Witherspoon, who is Chairman Lloyd's Advisor. Apologize, Catherine, for not seeing you sooner.

MR. JACKSON: Good morning and thank you, Susan, and the Energy Commission and the ARB for allowing me to give you some thoughts on lessons learned from past strategies to reduce petroleum dependency. I'd like to acknowledge my co-author is here, Nalu Kaahaaina, who's in the audience, and Scott Fable, who worked on this presentation.

What I would like to do here is to go through a background; kind of give you just sort of a perspective of when some of these strategies were put together and how we responded to some of the oil crises of the past. And then kind of look specifically at three or four of these strategies and what they resulted in, and what we can learn from them. And then finally come to a summary.

If you look at this from the point of view of oil price throughout the '70s, '80s and '90s you can detect several places where we had sort of petroquakes, '73, '74, '78, '79, the Gulf War and recent rise in prices in late 2000, and potentially a combination of other factors that are going to cause even more pressure, upward pressure on the price of petroleum.

Some of us are old enough to remember this. This was the '73, '74 timeframe where we did have even gas rationing. We did have a supply issue.

If you look at what, the transportation sector is 97 percent dependent on petroleum, with an average annual growth rate of about 2 percent. It's even going to put more upward pressure on the price and supply.

If you look at this from an economic point of view, there's also a cost associated. And this left-hand chart here indicates around every major petroquake there was a major drop in our gross national product.

And you can see the '73, '74 recession; you can see the recession that's all nearly '80s. You can see a brief blip surrounding the Gulf War, and although 2001 isn't on here, I bet it's going to be closer to zero and maybe even negative.

You can also see that there's a cost in

terms of the trade deficit. So much money that's flowing out of the country also associated with those periods of time. So there is some correlation.

Paul adequately just covered this issue of the environment. SMOG, as well as toxics, has been a major issue in California; continues to be a major issue. So we've always talked about the problems that we have to solve in California relative to energy diversification or energy security, but we've also talked about it in terms of the environment.

This was adequately covered by Paul Wuebben, the amount, the improvement in terms of air quality is dramatic, but we still have a long ways to go. This shows a number of stage one and stage two episodes in the South Coast.

And that was accomplished, as Paul pointed out, with increased population, which corresponded both to increased vehicle miles traveled, so a tremendous job has been done.

Let me just kind of highlight some of the changes that occurred in those various decades.

1970s, obviously key sectors of the U.S.

economy switched from oil to natural gas, with reduced petroleum. There was a shift in terms of more efficient technologies, both on the automotive side as well as the appliance side.

Also there was legislation passed that would require domestics and imports to achieve higher standards from the automotive area. And there was a tax credit that was put on for ethanol to get ethanol into the marketplace.

Also there was considerable investment made in petroleum exploration and interest in alternative fuels. We got things like the synthetic fuels program, renewable energy programs. Large, diversified supplies of petroleum were found in the North Sea, Alaska, Venezuela. And we also came up with the strategic petroleum reserve as a mechanism for solving some of the issues. And I've already talked about the recession.

In the '80s we started out with the recession. All the work that was done in the '70s caused a price collapse of oil in the mid '80s, and relatively stable prices for the rest of the decade, going into the '90s, except for the Gulf War.

There was a considerable expansion of interest in new alternative fuels. Brazil was doing ethanol; New Zealand was doing methanol and natural gas. There was methanol work done in Germany. Canada was looking at LPG and natural gas. Italy was natural gas. Netherlands was looking at LPG. All looking at resources that were sort of indigenous to their particular country to try to offset the issues of petroleum dependence.

There was also some key legislation, I just picked a couple here, in the '80s that were passed. There was the California AB-234. That was original legislation that actually was meant to require the use of flexible fuel vehicles, or a mandate for flexible fuel vehicles in California. It was changed in debate, legislative debate, to require a panel to study that.

And there was the Alternative Motor Fuels Act of 1988 which provided CAFE credits for manufacturers who produced alternative fuel vehicles.

So there was a sense in the '80s of the need to diversify our resources in terms of what was used in transportation.

In the '90s we started out with the Gulf War, a short-term spike in oil prices. And subsequently followed by a short-term recession.

The '90s are also characterized by substantial improvements in gasoline type technology. Increased use of oxygenates in gasoline, i.e., reformulated gasoline. Implementation of fuel injection and more precise air-fuel control ratios. Improved catalysts. And the result of that was that the gasoline technologies pretty can compete on an emissions basis with the alternative fuel technologies.

We also saw the Energy Policy Act enacted in the early '90s, which was intent on emphasizing the use of alternative fuels as a way of reducing our petroleum dependency. And there were some short term, there were some goals in there that was 2000 I think we were supposed to have a 10 percent reduction in petroleum. And in 2010, 30 percent. I'll give you some numbers where we are on that later.

Today we see OPEC re-exerting market power. We're also seeing the economy coincidentally falling. I would have to characterize the transportation market as still very very vulnerable on petroleum supplies and dislocation.

OPEC has considerable supply influence. Our refineries, as Commissioner Moore mentioned earlier, are at or near full capacity. And we're going to ask MTBE to be phased out of the gasoline supplies, which will even put more pressure on those supplies.

And although there was lots of work done in the '80s and into the '90s on alternative fuel markets, there's just not very much out there right now that gives us much flexibility in terms of reducing petroleum dependency.

And I think also in the '90s and today we understand the importance of greenhouse gas emissions.

Okay, let me just talk a little bit about some of the strategies. I wanted to do this in terms of looking at various components; there are improved vehicle efficiencies, advanced vehicle technologies, alternative fuels, influencing consumer behavior, policy and incentives. All these are panels that are going to come up after this first session.

I also want you to keep in mind that

when we're talking about reducing petroleum, we have to think about both the heavy duty and the light duty. You just can't say, hey, we we're just going to concentrate on the light duty, which, by the way, is shown here. In 1988 it consumed some 140 billion gallons of gasoline. Whereas the heavy duty is about 40 equivalent billion gallons of gasoline.

So you can keep that in mind as we're doing our discussion this afternoon. We need to look at both areas.

Improved vehicle efficiencies. Probably the biggest thing that was done in the early '70s was corporate average fuel economy. And there's experts in this audience, David Greene in particular, to talk about this more later.

But it was a uniform standard. You know, from the automotive manufacturers' point of view, didn't really account for buyer preferences, but it was forced on them. I think it did a good job in terms of educating the public on fuel economy. We got labeling on vehicles. We had testing that EPA brings out. And you can make a consumer choice based on fuel economy.

There are different standards for light

duty trucks and passenger cars, as well as for important domestic vehicles, all of which cause some issues subsequent to when this was implemented.

The result was that we got reasonably good improvements in fuel economy through the '80s, but as you can see in this chart, it sort of tapered off. And with the buyer preference of light duty trucks versus passenger cars, it's actually conceivably tended to level off and almost could go down if we continued on the percentages of light duty trucks.

We are seeing a recent emergence of high efficiency type of vehicles, although mentioning these, from Toyota and Honda. And we see this as a strategy that is probably the most viable for near term applications for reducing petroleum -- increase CAFE or restructure it in some way to increase it.

On advanced vehicle technologies the focus really has been on meeting efficiency standards. In both the light duty and heavy duty we are seeing more sophisticated power train technology, such as the advanced fuel injection, advanced catalyst.

There has been some market success in various places relative to natural gas in both light duty and heavy duty, but it's not overwhelming. It's a niche market.

And the result really has been some technologies have improved fuel economy slightly. But really what has been done here is to meet the emission standards, yet improve vehicle performance, horsepower, weight, whatever the various manufacturers see as selling. It could have gone in the opposite direction, but it didn't.

The 1990 Clean Air Act amendments really brought us a way of getting some -- performance, but also got us the oxygenates into gasoline which is probably the only viable strategy we have right now in terms of getting alternative fuels widespread into the marketplace.

Three billion gallons of -- one million gallons of ethanol, that's in comparison to about 160 billion gallons of gasoline used in the United States. So somewhere on the order of 2 to 3 percent was put in or displaced. So that's been one of the effective strategies that actually has --, not to the extent that was needed by

EPAct, but it did work, and it's still working. The infrastructure exists now.

Let me touch on two other ones here, the Alternative Motor Fuels Act of 1988. This was meant to give CAFE credits, to incentivize alternative fuel vehicles going into the marketplace. Flexible fuel vehicles into the marketplace. And the idea was once you got the vehicles into the marketplace, you could create a market for the fuels and then the fuels would come to the market and you would be able to use alternative fuels in those vehicles.

Well, that's a lot harder than -- especially dealing with the fuel at its higher price than gasoline. Very hard for the consumer to make that choice. So you have to do a lot more work to make that happen.

But just as an example, there was about 400,000, 425,000 alternative fuel vehicles. Of those, now about 40,000 are flexible fuel vehicles. Flexible in the sense that they can use ethanol or gasoline or any combination. But not much fuel is being used in those vehicles.

Energy Policy Act of 1992, EPAct, mandated that federal fleets maximize the use of alternative fuel vehicles. Similar mandates were for states and fuel provider fleets. And there was also a provision to bring that to the public fleets, also, which never got very far.

That did again get alternative fuel vehicles into the marketplace. But very little of the fuel has been used bringing them to the marketplace.

The use of advanced technologies can reduce petroleum consumption, but many of these technologies have either addressed emission performance or petroleum displacement is really not the main purpose. Or we've got the vehicles into the marketplace and haven't followed up on getting the fuel infrastructure into the marketplace.

Let me talk a little bit about alternative transportation fuels, and then talk about it in terms of two examples. First is Brazil. The largest scale alternative fuel deployment was initiated in 1975, and I think they got to around 10 percent, or 10 to 15 percent total alternative fuel displacement.

What they were trying to do is balance a sugar and ethanol production and lower their dependency on foreign oil. Initially this effort was supported by all the major stakeholders, the domestic automakers, the ethanol producers, sugarcane growers, the state oil company working to distribute the fuels, et cetera.

And the government controls the price of ethanol to facilitate the penetration into the passenger car market.

The ethanol-only vehicles peaked at 96 percent of new passenger vehicle market share in the late '80s.

Ethanol shortage in about the same time was due to global sugar markets prices had gone up, so it was more profitable for the manufacturers to sell sugar on the world market. Thus there was an intent by Petrobras at that time to expand the gasoline market share, resulted in a limited ethanol production and decreased ethanol reserve.

That particular program now is blending only -- pretty much is the ethanol vehicle sales never recovered from the drop and the gasoline market share continued to increase through the 1990s. At this point there's only 3.5 million ethanol vehicles remaining in Brazil that operate on ethanol, compared to 10.5 million gasoline vehicles. Ethanol sales are essentially have gone to zero.

They are continuing to use ethanol blended into gasoline, about 22, 23 percent. And that keeps the market and the business going. What you learn here is that government intervention requires really long-term vision and action, which is often difficult for politicians to build confidence in these programs. All shifts in policy can cause dramatic changes in consumer behavior.

And it really points to the fact that the government needs to build a consensus among all these fuel producers, all the stakeholders, all the major stakeholders, vehicle manufacturers and users in order to sustain a viable program.

LNG is another example I was using here for alternative fuel point of view. Liquified natural gas used in heavy duty vehicles -- U.S., primarily driven by a lower NOx strategy. LNG vehicles have about 50 percent less NOx than the current diesel vehicles. And about 70 percent less particulate matter.

You can monetize those benefits,

particularly NOx, in California these days to offset the increased cost of the vehicles.

Requiring these technologies, your rules and regulations can drive the technology development, but does not necessarily guarantee that you're going to have a market in the future.

Alternative fuels can significantly reduce petroleum dependency, but require a delicate balance of the supply and demand and the technology that goes into it. And we may be operating, in this case, on a short window of benefits, emission benefits. As the diesel technologies improve, will the LNG technology improve. Will we be able to develop enough of the marketplace to get the cost down on these vehicles; it could be diesel has the lower emissions. Those are all to be seen.

So, again, there's no guarantee that emission performance standards are going to force alternative fuels.

One real brief example of maybe influencing behavior, most of you are probably familiar with the experience of the Arizona program. Here the state offered fairly substantial tax credit incentives to convert vehicles, to build fuel, either on gasoline or natural gas. The program was not capped in terms of how much fuel you would use or if the vehicle, whatever used alternative. Also wasn't capped in terms of the amount of money that was spent in the program.

And what you ended up getting was people that were using this incentive to influence their buying preference on vehicles. So, you would get people that were using this incentive, for example, on the extreme, to convert an SUV with a very very small amount of natural gas capability. And you were using it to buy that SUV to upgrade to an SUV. This is probably an example of a broken --

Some other policy incentives. The SCAQMD 1190 rules mandating again the use of alternative fuels specifically for the benefit that's gleaned from emission standards from a primarily toxic, but also NOx. The question I have here is as the diesel technology becomes cleaner and cleaner, as they meet the 2007 standards, and the natural gas technology cannot keep up with the pace. It's a question will South Coast be able to maintain the political clout to keep these rules in place. There's lots of doubts on these.

The Carl Moyer program was a NOx incentive based program in California. I think it's been one of the most successful programs run for a variety of reasons. But it does provide incremental costs for buying down NOx emissions. And it has been very very successful in California. The first two years of it, I think, $3000 average dollar-per-ton NOx compared to a limit of $12,000 to $13,000 per ton. Another mechanism that could be used to incentivize.

Our conclusion here is that public policy should be based on the benefits that can be verified. Monetizing such benefits not only enables comparison, but enables structure to the incentive levels.

And a policy really needs to be carefully crafted to achieve not only the desired goals, but to balance cost effectiveness with technical feasibility.

Let me close. Gut feeling is that we need to diversify fuel supplies in the transportation sector. I think everybody recognizes the needs. We have limited supplies and, -- resource. Reserves are obviously concentrated in very politically unstable regions of the world. I should say region probably.

And we do have considerable price volatility that we, as Californians, and the rest of the United States is going to have to deal with in the next four or five years. But we have substantial -- it is not cheap to duplicate the infrastructure, existing infrastructure. And it's a question of is that really needed, do you really want to duplicate it.

Higher fuel costs potentially for some of these fuels. So you may have overall lower life cycle costs, but you may have higher initial costs. Why does the consumer want to do this -- want to use these higher priced fuels?

And then finally, to me, the benefits with energy security. It's hard to quantify in terms of whether it's a monetary effect. Some have done good work here, but as you see in the early part of the presentation, there are definitely some effects relative to having price dislocations in the petroleum sector. These are hard to quantify.

I don't think there's any silver bullets here. Obviously we've got to improve the efficiency of the vehicles. I think implementing alternative fuels is an important thing to do, but it really requires consensus among all the stakeholders. You can't have one not agreeing to do this. And they have to agree to do it over the long term; it can't be a short-term thing.

The need to implement some of the transportation demand measures has been mentioned already, the ridesharing is a good example. To reduce petroleum dependency will require actions on all these fronts. There will be a need to do a little bit of everything.

Finally, I think improving fuel efficiency is critical to this discussion, and we're going to hear more of that in the first panel. Advanced vehicle technologies offer the potential to decrease petroleum consumption, but are often based, or have been in the past, based upon emissions. They can be complementary, but they've got to be addressed at the same time.

Alternative fuels require really the consensus of the major stakeholders, fuel suppliers, vehicle manufacturers and users. We can't do "build them and they will come". We've seen that doesn't work at all.

Two examples are shown here, natural gas fueling stations in the early '90s, hoping that the natural gas vehicles will get there. They didn't.

Another example is the flexible fuel vehicle. Without having some sort of teeth in terms of getting the fuel to the marketplace and getting the vehicles there, it doesn't work. Or getting the fuel there without the vehicles doesn't work. So you really have to closely match both the vehicles and the fuel.

And the life cycle cost for alternative fuels has to be, in my view, less expensive or at least equal to the conventional fuels or this isn't going to work -- how you get there, it's a big question.

I think you can conclude that consumer behavior can be adjusted to minimize or reduce petroleum. But you really have to target verifiable benefits to avoid over-incentivizing.

And finally, incentives and mandates must balance cost effectiveness with social benefits.

Thank you for the opportunity to present our views on the lessons learned. And I hope at this workshop we'll be able to bring out -- forward in terms of reducing petroleum dependency in California.

(Applause.)

MS. BROWN: Thank you. I want to call Dr. Lee Schipper, who will be our last speaker before the break. And I will allow some time for questions of the panel following his presentation.

DR. SCHIPPER: Thanks. I want to thank -- bring me here, I want to thank Commissioner Rosenfeld who was my first graduate advisor in 1970-something. I hope --

(Laughter.)

DR. SCHIPPER: I moved to London two weeks ago, and I've been looking for Welshmen and can't find any. I fly 6000 miles --

(Laughter.)

DR. SCHIPPER: -- at the door to the hearing.

Many years ago the visionist Bernard Cohen said petroleum was -- well, I never endorsed that view, but I did drink the exhaust from one of the Daimler zero emission vehicles. I drove a Ford, almost hit a squirrel; it was going to be the first DEB roadkill. This was a Volvo fuel cell bus, and our friends from Toyota, the Prius. Many less have -- you can find these vehicles all over --

MR. SPEAKER: And I have one.

(Laughter.)

DR. SCHIPPER: My point is I was asked to summarize some of the international lessons, and I will do a plug for, as an ex-IEA person, very important, I'm unemployed right now -- this is a book that we wrote. I will give one copy to Commissioner Lloyd. I will let the five Energy Commissioners fight over it. I think you can order them from the IEA website.

But I want to emphasize I'm speaking as an individual. I really am unemployed right now.

I think you'll get a copy of this handout or already have it. Basically we looked at what happened in five European countries and the U.S. effort to reduce the CO2 emissions from transport, which essentially means reducing petroleum. Not exactly. And to be blunt, we looked mostly at Europe because you really can't see anything with these.

One official commentary said, well,

we're planting trees in Costa Rica. I said that's not what we mean by transportation policy. And I'll come back to that issue.

A lot of things are important to this effort, and I just want to highlight them and challenge California to decide whether those things are acceptable to California.

First of all, scarcity of oil and gas. I don't believe that's a factor -- the IEA world energy outlook emphasizes that. If you look at the petroquakes in Mike Jackson's graph, each one is lower and lower in real terms. Fuel price spikes are costly, but basically I personally and most of my friends in the oil business don't see the supply of petroleum and what will drive us away from this dependence. OPEC will always be there, we'll always be bouncing around. And -- transport has already expressed its willingness to pay more.

Instead transport and environment policy go first, and I think we saw that in the addresses from the Air Resources Board. Everything's on the table; serious local land use planning. Carbon emissions a driving factor in Europe but not here. Technology marches on, but as David Greene and others will show you, most of the fuel savings in cars in the U.S. today, new cars, use roughly 40 percent energy per mile per kilogram than they did 20 years ago. The kilograms -- the power is gone. So while the technology is there, it's not clear what it will be used for.

The economic forces -- are very very very important. I'm glad to see Susan Brown recognize the previous -- I think that's very very important. But also richer people tend to move about more, but there's some changes in that.

That's very very important, but in Europe there is no coddling of the consumer. There are no courses of violins, choruses of violins saying we just can't make ourselves pay 3 cents a gallon more. The Europeans did not send their energy minister to OPEC -- for lower prices. Only the country with the highest incomes and essentially the lowest prices did that. Very very important.

During the high price spikes of September and October last year, the Environmental Minister of France wrote an op-ed saying we are defending our eco taxes, we can't back down now. And while Tony Blair did some sleight of hand, the

British didn't back down either. And the second big trucking demonstration wound up in four or five trucks and a few tractors. Even if they'd had some Welshmen in there, it would have been different --

(Applause.)

DR. SCHIPPER: So the point is you have to recognize the importance of those. And obviously I personally believe from the European experience you need price signals everywhere. And I'll get back to what I mean.

Certainly the voluntary agreements on improving fuel economy are helpful, but they will be supported by the present -- and there's just one, there's some data things I'd like to show later. Again in cross-section, if you look at light duty vehicle fuel, this is plotted as emissions, but the fuel, what you see is the European countries and Japan with relatively high prices and low consumption.

The U.S., Canada and Australia there kind of is a relationship there. Most of those differences are -- two-thirds of that difference is VFT per capita and one-third of the difference is miles per gallon.

But again, if all is on the table one has to look at all of that. And it's hard to say if people save fuel when in a sense fuel keeps getting cheaper and cheaper in real terms in the long run.

We developed this accounting model that says oil and transport is just a, if you will, the vector product of total transport activity -- into the modal shares, each mode getting its energy intensity, and each fuel represented in the final. Again, we all know there are lots of places to push, but you got to push on them, and you have to do it in a coherent way.

And California is one place in the world that has the ability to do that, in part because of the unifying factor, unfortunately, the air pollution problem. Most of us are in the three large air basins. There are a lot of reasons to consider everything together, including land use.

What did they find in The Road from Kyoto? The potential is huge, but because progress is slow, particularly even fleet turnover, certainly things like land use, the political risks are very high if you can't show results quickly.

Incidentally, one of the problems in the California basis is like every other state, we don't really know how many VMT there are; we don't really know what the fuel economy is, because we do each of those in a circular way.

The U.S. last measured its fuel economy with surveys in 1985. So, it's all guesses. Now that didn't matter in the '70s and '80s when things were changing. But now when it's politically important to see changes, one has to start to measuring.

And when I did my project for the Commission on California energy seven years ago, we found that the Energy Commission is a very very good model, but there wasn't enough measurement. How far our cars are really driven in California, and what is the real fuel economy. And that's something we have to get moving on, otherwise we won't be able to show progress and validate our policies.

Price signals are all over the European map. I'll get back to that. The technology investment comes mostly in the U.S. through PNGV or PGNV or -- vehicles, something like that. And in Japan, okay, you'll hear a lot more about that.

The point is what's missing from the U.S. is something driving the consumer, and that was brought up in Mike's talk.

Open the books in the late '80s in Holland using all these great ideas, and then you open the laws today and see what's on the books by what was bold, after compromise and compromise, is very little. It's a very very slow and slippery slope as we know from the California experience.

And that, plus the number of years it takes to see the impacts, means the people are disappointed. I don't mean to shrug this off, but you have to sort of start with that as your outcome. And say, what do we have to do to build in various policies that we know aren't going to realize benefits for awhile. We know we're going to make people mad, but we know we're going to have to be compromised. Okay. At least that's what you see everywhere in Europe.

Now, the voluntary agreement says 25 percent reduction in carbon per kilometer in new cars by 2008. They wisely -- carbon, because remember diesel has more carbon per liter or per Btu of energy. European cars, we found, when we applied -- were to the fleets of Germany and

Denmark. Given the size of the European car has more fuel saving stuff in it than a similar American car. Not a lot, but it's a measurable difference.

On the other hand, the cars in Denmark, where there's a 200 percent purchase tax, had somewhat less energy saving features than the cars in Germany, where the purchase tax is much lower. So vehicle taxation is important; fuel prices have brought out some differences in what technology is deployed in a given size.

It also helps, dirtier fuels tend to be taxed more. Nobody needed a small filler nozzle to force people to unleaded -- costs 40 cents a gallon less, the lead, that was the way it was introduced.

And in the northern countries they needed cars at a lower personal cost access than the less clean cars. There is some talk of charging for road use in Holland in London and other places where it's really congestion, and again I mean congestion that we don't know and experience. And to charge trucking by kilometers as a way of really internalizing charging for the use of the roads and the environmental problems.

But again, part of a larger package of trucking, not just spotty measures. And then what I call soft measures, I don't mean they're not important. But, walking, planning, the trouble is that in many of the more dense European countries you have these important and good land use planning. You can't put up a WalMart or its equivalent that's not near a major existing road or transit node in many localities. You can't do it.

And so you don't get the decay that we get. That's because European countries have long recognized the importance of land use planning. And frankly, we have not. You see clear boundaries in European cities. You don't see that in this country, it seems to just gradually peter out.

There is sprawl. The large rail systems in London and Paris mean the average commute is lengthening as people use rail. It's expensive but they use it. But it also means that the overall scale of the sprawl is much smaller.

The main item in Europe today, however, is the fuel economy voluntary agreement. Local measures help this. Fuel taxes help -- the kilometers. But the biggest single thing on the books is the fuel economy voluntary agreement.

Now, there are some contentious issues. Publish a paper in the Journal of Transport of Economics and Policy that says diesel is a loser in Europe. Why is it a loser? When you look at the real on-road fuel economy of diesel, and you look at the lower price, even if you assume a small -- I think the effects are small -- what you find is that people first of all buy the more -- cars if they're buying in the diesel market, and they drive them 50 to 70 percent further. And this isn't just the high drivers.

In surveys of switchers, people switch and drive more. And the same is true of LPG in the countries that have it. And I say to California, subsidizing alternative fuels leads to this great place for high mileage drivers to enjoy themselves. And nobody has won by that.

The net impact of dieselization almost half the European car market today is a way of getting cheaper fuel. Now, France is raising the price of diesel at the risk of having truck drivers block all the entrances into Paris, which is what they do now and then. And once the fresh salad dries up in the Parisian markets, the political will will kind of wilt, as it were, --

(Laughter.)

DR. SCHIPPER: -- the salads, and you get -- but this time, last year they didn't give in, and we finally see a change. And the real challenge of diesel is now for fuel economy improvement to move so fast that it still offers an interesting alternative.

Some of you know that I often write alternative fools, not because I'm not for them, but I think that a fuel like farm ethanol, which according to Michael Wang, in this country is three-quarters somebody else's fossil fuel, and one-quarter of real bioenergy. It works only because it's heavily subsidized. Not because it's something the consumer would choose.

We have the same problems in Europe. Everything that was made cheap because it was supposed to be good, LPG in France, for example, starts to boom because it's cheap, not because people suddenly put on their little green hats.

A couple countries tried accelerated stock turnover and this got nowhere, -- didn't work, either. In other words, the indirect ways with incentives tend to have very small effects, I think, at very high costs.

Land use is extremely important, but you need very hard planning. To me all of the talk of HOV lanes and location emission -- all of this is window dressing unless one addresses the fundamental tax policy.

And during the most radical of the times in this country, talking about tax reform, nobody will attack the single, the mortgage interest deduction for owning your own home and paying interest. That's a great incentive to go where you can buy property.

And again, living in north Berkeley I can't complain about this; this is the redevelopment of an area that was so tragically burned out ten years ago. And somewhere in the Highlands there there's actually, they snuck in a 7/11.

The contrast that on top of a freeway with the Ottawa style development on the right where you have apartment buildings coordinated with a dedicated bus way. And look at the north Berkeley BART station, except you can't see it, because us good citizens of Berkeley didn't want development around the BART station. We forbade it. So it's mainly a parking lot, which gives you an entrance to a freeway on rails, as opposed to the Orleans us stop way out the Autobahn that's on top of a Hudson Bay Company, and several other major stores.

If you're going to do things like spend millions in mass transit, you need fuel prices, you need the land use, you need all these things to make it cheaper, make it feel cheaper and faster and more convenient than the alternatives. And for most Americans, that's simply not the case today, as we move to where only a minority of people are using commuting --

We know what the incentives are. I think they were all discussed earlier. There is a fee base on in Denmark right now based on the original mile per gallon of your car, every year's registration fee varies. And there's some evidence that that's tweaking the market, but the Danish market is 140,000 cars a year.

So no manufacturers are going out to design the new technologies based on the Danish fee base. There is a slower rise in VMT that we see in the U.S. relative to GEP growth, and that's in the statistical package I put together.

Europeans foresee this, but in California that's something that everybody's, oh, we're all going to move to Arizona, or we'll all move to Colorado. Okay.

So one of the difficulties that Europe faces, like California, is one state no longer can do anything. All countries have to do it. And they do it through EU.

The problem California faces is it's probably many years ahead of the federal government, and when it tries to do things here it often can get stopped actively, because it's just too far out.

Again, there's all kinds of things that are, I believe, going in in good ways in Europe that they're part of a culture that we don't have. And I think in a sense that's -- we have to think about here.

We've led the world in clean vehicles. We've led the world in home appliances. I visited the major Japanese appliance maker in 1979. He showed me a secret piece of paper, very sensitive. And there was its projected refrigerator consumption and the California standards on the same piece of paper. California basically pushed the whole world, at least the developed world, in making better appliances and making cleaner vehicles. The Swedish standards depend on the California standards.

On the other hand, you don't get inside your refrigerator and drive around in it. And so there's something emotional about cars. We understand that. And we bring up problems of order issues. But somehow everything always seems to fall apart. My fundamental belief is the difference in the policy. Europe and Japan are highly consensus oriented; the U.S. loves, David Greene and -- may describe it, by going on with the national academy study.

One, you didn't need a national academy study to make fuel economy a goal in Europe. Two, once something like that is done by the elders, everybody agrees we'll do our best job. And that is what European producers, Japanese car producers tell me all the time. A tough fight. Went to Honda, visited all the centers in Japan, tough fight. I was there the day before the new agreement was announced. They said it's going to be a tough fight and we'll do our best.

You don't get that from anybody with U.S. policy. Japan and Europe are not afraid to use pricing -- seriously. Again, if you only fiddle around with it, you often get very very perverse results.

And another thing is Japan and Europe really are committed to the Kyoto Accord in one form or another, which I think it's fair to say it is not an issue here.

Think of it this way: We built the red line, the blue line, the green line in L.A. and somebody said, estimate that if every rider costs the system between $10 and $20, well, all of you saw "Blazing Saddles". And you all remember when all the bad guys were going to ride to destroy the town of Rock Ridge or Rock Creek or something like that. And they came to this semaphore and you had to put in a dime to pay the toll to get by.

(Laughter.)

DR. SCHIPPER: If society says it's worth building a light rail system that costs $10 to $20 a ride, then what society is saying every drive lane in each one of those, and the driver's got to pay $10 to $20 to open the car up, otherwise what you're doing is spending hundreds of dollars here to solve a problem that would cost tens of dollars over here.

And that's, to me, the ultimate lesson. That California is going to do things to restrain the growth, to make it go back down. They start to do stuff that's strong based on what I've learned from six years in Europe, or I think we'll have this hearing next year and the year after and the end result is this is the 20th or 30th year we've been in these hearings.

And while I recognize, and I think California should recognize its own leadership, the energy and environment, we're in a very slippery area, transport -- control of it, and I think we learn that historical lesson.

Thank you.

(Applause.)

MS. BROWN: Okay, I assume you're involved in formulating some very good questions for the panel. We'll allow a few minutes for Q&As. And if you do want to ask a question of any of the panel members, and I think even Dr. Lloyd would allow a question or two, right? You could come to the podium there and identify yourself for the court reporter.

Where are all those difficult questions? Comments? I think these people want a break.

(Applause.)

MS. BROWN: Great, thank you.

MS. PFEFFER: I do want a break, but I'll ask a question. My name is Nancy Pfeffer. I'm a Planner at the Southern California Association of Governments. We are a COG, a Council of Governments, in southern California; six large, large southern California counties.

And my question for just suggestions and input from the panelists, we talk about how critical land use is, and of course at SCAG we deal with that on a regional level as best we can. But ultimately it is an issue of local control and local jurisdiction.

What are your recommendations, suggestions for creative strategies for dealing with that?

MS. BROWN: I guess I would turn it around and ask you what you would recommend, as a local planner, to the panel. We are going to have another session on smart road strategies, I believe, tomorrow morning.

But I would also offer that we're

looking to you for suggestions. How's that for turning around the question?

DR. SCHIPPER: If I could just say something from Europe. That's recognized, at least in Germany, with all five European countries looked at, that the local authority has really the say.

In the case of the UK, planning, there's a document that came out five years ago, PPG-11, and it basically said, okay, localities, do it, it's not our problem. On the other hand, London is 25 percent of the UK, so that kind of drags the country along.

Holland, I mean there's open space, but basically Holland is one or two large megacities in a certain sense, and then a lot of rural area. And so in Holland, again even if it's a local level, it only requires a few localities around that area to do things. And there's a lot of respect for the importance of doing this.

In Germany it's extremely a local issue, and so you see it missing from a lot of the national issues.

But if you look at what cities are doing with bike paths and things like that, and what we would call smart growth, they're doing a lot. I mean, people don't like the cameras that record people that go through red lights in Frankfurt, but it slows the traffic down. It's very very good.

Sweden has always had a division of land use planning and clustering developments around each transit stop. It's very very important.

Denmark, again, is so concentrated in one or two cities that what becomes -- the Danes have the five-finger plan, there are five big sort of arteries radiating out of Copenhagen. And basically, although people can locate single family dwellings between them, most development is along those five fingers.

On the other hand what no one ever realized was that there would be people doing this. Because don't forget, even Europe is changing away from radial commuting. And the crisis in Europe planning right now is how to deal with the fact that people are no longer commuting radially like they did 25 years ago. And that there is more and more of a spread of jobs and things like that, or people have two jobs.

So, you can't expect the planning and

the collective system will carry the whole burden. But it still carries as much as 40 percent of people during peak commute hours. And we have an example of that in New York City. New York City is like Europe in the sense that the transit system carries a large, large share.

In the Bay Area transit carries a third of the radial commuters. But the radial commuters are only a third or even less of all the commuters. And that gets back to the question of how to collect people so that they don't have to move around as much.

MS. WITHERSPOON: Hi. I'm hoping over the course of this workshop we find out the powerfulness of each measure in terms of displacing petroleum, and begin to bound priorities. But on transit specifically, when we looked at it from an environmental perspective we discovered, much to our dismay, that transit could be higher polluting than cars unless you were looking at hydrogen buses or something of that nature.

And I'm wondering how sophisticated is the analysis of fuel efficiency on the transit side. And if transit has to take a particular form to displace petroleum. And, you know, for example, is it more powerful to get people out of SUVs and into lightweight passenger cars. Or to actually move them out of SUVs onto transit conveyances.

DR. SCHIPPER: In Europe transit is roughly three times less energy intensive than the U.S. I think we have about as many seat miles per capita as Europeans, but we have mostly seat miles and very little passenger miles, just saying people on a bus, averaged around the clock. Okay. In other words, we're below the threshold in almost every community.

And so the average city bus in the U.S. today uses more fuel per passenger mile than the average car. That may not be true for light trucks. If you can get people into existing buses there's essentially no energy cost, and that's the question.

But the strategy for the last 30 years was to subsidize more and more buses running around more and more empty. And so the fuel intensity of bus travel --

(Laughter.)

DR. SCHIPPER: -- within cities, city

buses went up, while the fuel intensity of vehicles went down. And what beat the vehicles was air travel. Now air travel gets us much longer distances. And cars get us farther than buses. There's a lot more than just energy intensiveness, there's time and speed.

I think the -- because of section 15 in the report, the analysis of the fuel use is really pretty sound. It says you got to get people into the existing buses off peak and things like that.

For example, in London, after 10:00 in the morning, an all-day, anywhere car costs very little. Before 10:00 you can't do it. And that's an effective strategy for filling in the valley when the buses and the railways won't be that crowded. And saying to shoppers, you can everywhere now for only four pounds, so why take your car. That's the kind of thing one can explore to fill up the vehicles when they're not needed.

MS. BROWN: Please identify yourself.

DR. FRANK: Hi. I'm Andy Frank, Professor at UC Davis. I'm the Director of the Hybrid Electric Vehicle Center.

I've got a couple of points to mention.

It seems like, to summarize everybody's presentation this morning, the long-term policies on alternative fuels has been kind of a bummer. And when I see here in the State of California because nobody's using it, even though we have programs assigned.

And all of this came down to a lack of infrastructure, as I see it. But that means any kind of alternative fuel system must use the infrastructure that already exists for energy. And we only have three, natural gas, gasoline and electricity.

But I didn't hear anything this morning on the use of electricity as an alternative fuel. I think electricity is, I think, an excellent alternative fuel.

And what we have been doing is designing hybrid vehicles that use both gasoline and electricity. Not like the car companies hybrid vehicles which don't use electricity.

And that's a distinct difference. And I'm fundamentally here to advertise a recent study from EPRI. You might say, well, that's obvious, EPRI wants to use electricity.

But what we find is that in the studies

that hybrid electric vehicles using electricity from the grid is number one, much more efficient over two to three times as efficient; satisfying to CO2 criteria, much less emitting, perhaps one-tenth; and the bottomline is the incremental cost is within the target cost of what people pay for cars, within 20 or 30 percent.

You might say, oh, my god, that's a huge difference, but I have to -- but it's new technology and it has new benefits. And the most important thing is historically new technology has always cost more.

For example, 1940, people forget that all cars had manual transmission systems. Automatic transmission came in at an introductory price of over 30 percent incremental cost. And yet two or three years later everybody had automatic transmissions.

And in fact, I remember the discussion -- I'm an old guy -- that everybody said who needs this automatic transmission, I can do a much better job of shifting, I know how to shift.

And yet, the benefit to the customer, and I think one of the people here mentioned it, the benefit to the customer was enough to drive that.

Same thing with the plug-in hybrids. You'll find that, we did this survey in this EPRI study which indicated that people would much rather plug in than go to a gas station. As a matter of fact, it reduced the numbers of trips to a gas station, in the study, from 30 to 40 a year down to three or four. And that was a tremendous benefit that people perceived as something that they will pay for.

Anyway, i'm here to advertise the EPRI study. It's called, Comparing the Benefits and Impacts of Hybrid Electric Vehicle Options. And the most important thing is this book is free.

(Laughter.)

MS. BROWN: Thank you, Dr. Frank. I wanted to point out that Bob Graham from EPRI will be speaking on that very study this afternoon. So we'll be discussing that in great detail.

Other questions for the panelists?

MR. SMITH: Dave Smith from BP. As the speakers were talking about the anticipated increase in petroleum use over the next 10, 20 years, there didn't seem to be any projections of air quality over the next 10 or 20 years.

So, I'd like to ask the panel if there's information that they could share about that. Because we've seen marked improvement in air quality over the last 10 or 20 years. What do you project to see over the next 10 or 20 years with the current systems and standards we have in place?

MR. WUEBBEN: From the local perspective we certainly would anticipate, I would think, some continuing progress, but the rate of that progress is certainly not guaranteed. And, in fact, I think as we found several years ago that there was a risk with the population and VMT pressures. That, in fact, that that rate of emission reduction would basically bottom out.

And while I think that with the most recent round of LEVII and reformulated gasoline and heavy duty emission standards has delayed that deflection point, if you will, there are other decisions. For example, the federal EPA decision to delay by three years the NOx standard puts even greater pressure on California, perhaps, as well as the near term. MTBE phase-out, you know, we recognize some of the challenges there.

So we don't have a specific forecast that I could bring to you today. We're certainly cognizant of all the factors that would play into that. And I guess we're really looking to the technology trends of this workshop, and some of the discussions to kind of flesh out those predictions, Dave.

CHAIRMAN LLOYD: A couple of things I'll mention, also, Dave. I think the contrasting some of the things that Lee was saying for Europe and California. Number of occasions I've heard European scientists and regulators basically saying that basically the urban air pollution problem has been solved in Europe. I don't believe that. But the tendency is that they're focusing on the CO2 rather than some of the criteria pollutants.

I think over here, however, you will also see some of that increased emphasis on CO2. But we've got a long way to go to solve the issues with the criteria pollutants.

As many of you will recognize, the issue we have, the Air Resources Board, in looking at the Bay Area air quality plan indicates there are many many challenges out there.

In addition, we are not wiling in California to relax the NOx standard in order to accommodate increased penetration of light duty diesel. The Board rather wisely said the same standard for gasoline and diesel.

If you look at the data we have for exceedances of the PM10 or PM2.5, or PM10 here, we have 90 percent of California basically being subjected to air exceeding those standards. And the more we see about fine particles as I mentioned earlier, down to .1 and .01, I think science tells us in the relationship between air pollution and asthma is that we've got to be more and more concerned.

So, as we look ahead I think it's important that we recognize we're going to continue to exert controls on all the sources, stationary, mobile, off-road, et cetera.

And given the challenge of models there and the data required to drive those models, I think we're going to continue to be very vigilant. To me, again I have to get a plug in there, along with Andy Frank, I think the importance of some of these inherently cleaner technologies can be very important. So our confidence of meeting those standards will be enhanced.

And also you see more and more, I know Dave Beebe is working with the auto companies, but last week at a hearing General Motors is just the latest of the companies saying we want to take the automobile out of the environmental issue.

So I'm hoping that that trend will continue and that we will see real progress. But I think we still have a lot of work to do in regional and urban air quality issues.

DR. SCHIPPER: If I could just add something to that. A key issue in Europe today is particulate matter. BP, Shell, ELF, which is the French company, I think have really been leading and pushing and making this stuff available. And BP was all over the CO_2 meeting in the Hague advertising its city diesel.

And city diesel really was kind of invented by, I guess by Shell, and probably BP in Sweden. BP makes the stuff available now.

I think a crucial decision that has to be made is whether to support really stiff regs on diesel that the previous president proposed. If we get that, then that's one more step to what Al just said, of getting some of these contentious issues simply off the table.

And in this case there are now enough of the largest oil companies in the world making this stuff and making money, and finding that in many European cities actually booming, you know, the green diesel, that that's a crucial thing that has to happen in the U.S. It may have to happen first in California.

When that happens I think you'll see some of the fears of an increased use of diesel taken away, at least on the PM thing. And certainly the problem of PM10 in existing diesel engines will be made a little better.

MS. BROWN: I'm going to suggest now we take a 15-minute break. We'll convene the next panel at five after eleven.

I also have for the next, the speakers for panel one please meet with Dan Fong during the break.

(Brief recess.)

MR. FONG: Thank you very much. For the record my name is Dan Fong; I'm a member of the Staff of the Transportation Development Office. I'm going to serve as the moderator for this panel on fuel economy and vehicle efficiency.

This morning we have a group of very knowledgeable panel members: David Greene from Oak Ridge National Laboratory, one of our consultants; and a consultant to the National Academy Sciences Study, Mr. Duleep. We also have a representative from the Automotive Alliance, Steve Douglas; and finally we have Roland Hwang from the Natural Resources Defense Council.

So I'm going to start this off by inviting Mr. Greene to make his presentation. And then after each speaker finishes we'll have some time for questions.

DR. GREENE: Thank you very much, Dan. I'm very happy to be here this morning. It's an honor to be invited out here to address the Commission.

The subject of my talk will be the recent National Academy of Sciences study on the corporate average fuel economy standards and their effectiveness and impact.

I will be addressing primarily two aspects of that study, we have numerous findings and numerous recommendations and there's not time to go into them all. I will touch briefly on the implications of our analysis of technology potential. And then spend most of my time talking about the -- on safety.

One of the major findings of the committee was that the CAFE standards had, in fact, had a salutary effect on fuel consumption in the U.S. We estimated that CAFE and other factors, including the price run-ups incurred at about the same time the law was passed were responsible today for reducing U.S. petroleum consumption by on the order of 2.8 million barrels a day.

A lot of the report is dedicated to finding or exploring preferable alternatives to the fuel economy standards. I'm not going to say much about that, but I'll be happy to answer questions about that if people have any.

We recommended a lot of things people got from gasoline taxes, such as Lee Schipper advocated this morning, to tradeable credits, to weight-based standards, and so on and so on.

But then the majority of the committee, with the exception of Mary Ann Keller and myself, agreed that the CAFE standards were probably costing the U.S. somewhere between 1300 and 2600 fatalities per year. Not just the CAFE standards, but all of the downsizing and down-weighting that accompanies that. And we strongly disagree with that. We think this is a serious error, and that the better estimate is about zero.

A few other refinements, since these were questions raised by the Commission's -- questions they sent to me. We did say that the definition of a truck was broken, and needed to be fixed, but we didn't tell the National Highway Traffic Safety Administration how to fix it.

We said that the domestic import distinction at least has already been abolished for light trucks. It should also be abolished for automobiles.

We noted that, as Michael pointed out this morning, the credits under EPAC for flex fuel vehicles tend to reduce the average miles per gallon, and have failed to generate significant demand for ethanol.

And we also pointed out that the technology that could have been used to improve fuel economy has been implemented instead since 1985 to increase performance and size, accessories and so on.

We also noted that there is a legitimate government rationale for taking action to raise MPG. We assigned a very approximate externality charge of about 30 cents per gallon.

Okay. The findings on technology potential are in chapter 4 of the report. And they are summarized in what we, I think, mistakenly called a break-even analysis. And the reason it's a bad idea to call this a break-even analysis is that people assume that it means that the total cost to improve fuel economy exactly balances the total value of fuel savings to the consumer. And that's, in fact, not the case.

It's not a break-even point in that sense. It's the point where the marginal cost of improving fuel economy one more increment equals the marginal value to the fuel savings. And the economists will recognize that that means that the total value of savings to the consumer far exceed the total costs, generally by one and a half to two times as much.

So, whereas the news media said, well, you can have fuel economy but it's going to cost you $1000 or something to improve fuel economy by say 8 or 10 mpg, they failed to point out that you might get $1500 to $2000 worth of fuel savings over the life of the vehicle as a result. And that was really our fault for not being clear.

And also in our break-even analysis we don't include the societal benefits, even the 30 cents a gallon which we came up with is not included in there. So any societal benefits for carbon reduction and so on are a bonus.

The technologies we considered are all proven technologies, not necessarily all in the marketplace now, but known to be feasible, known to be possible at a cost which we have specified. And we give a range of costs and a range of fuel economy improvements for every technology.

And our break-even analysis assumes no weight reduction whatsoever, but 5 percent increase in weight to account for expected additions of safety equipment and other things to motor vehicles.

I should say that it covers the time period approximately 2013 to 2015, so there's plenty of time to change over technologies.

I'm going to pass over this quickly, but ours is not the only analysis available. There are at least four other very carefully done studies, very recent studies of fuel economy technologies potential in the literature. And it does go quickly, doesn't it?

Here you see our range of estimates which is characterized by a solid black line for our average estimate and two dotted lines for our high/low estimates, showing a potential for passenger car fuel economy increase in change in miles per gallon versus incremental costs, along with several other of the studies that are extant, including this blue line which shows K.G. Duleep's work. He'll speak next. A study done for the automobile industry, Sierra Research, and then later released by Natural Resources Canada.

You see inferences we made. The MIT and ACEEE study don't really lend themselves to constructing this kind of cost curve for reasons I can elaborate on. But we made inferences as to what the indications were. And obviously they're far more optimistic about what can be achieved.

Of course, the MIT study applies to the year 2020. And whereas our study, Sierra Research study, and the EPA studies do not assume technological progress such as assuming a device to effectively control NOx emissions for lean-burn engines. We don't assume that.

The other studies, especially the MIT 2020 study, does assume what the engineers at MIT believe to be a reasonable rate of technological progress. So this is interesting to characterize it what a study based on essentially fixed technology concludes versus one which anticipates technological progress.

You can see from the passenger car one that the other studies pretty much fell within our range of high and low estimates. And that's not quite the case for light trucks.

Our study is more optimistic about what can be accomplished with light trucks. And in fact, we expect that bigger efficiency improvements can be achieved for light trucks than for passenger cars.

So, -- you have to have a light finger for this -- so, if we can have improvements -- I missed a slide there.

(Pause.)

MR. GREENE: That one, yeah, that one skipped, went by too fast. I should point out this, I think, if our key finding about technology potential. We said that there are technologies that can improve fuel economy significantly over the next 15 years.

The range for passenger cars, which essentially goes from the least for the smallest cars and the most for the biggest cars, is 15 to 35 percent. The break-even analysis which I have characterized; 25 to 45 percent for light trucks. And as I say, it includes no weight reduction, even though I believe that it probably should. But it's heavy on these drive train technologies.

Okay, now, so if you can do all of that, and it's cost effective, why not do it? Well, some people say there's a potential safety risk. And I want to spend some time talking about that.

Mary Ann Keller and I very strongly disagreed with the National Academy reports, the conclusions on this subject, in regard to safety. I hope that especially if there are any safety experts they will have a chance to read it and maybe respond to us about what they think.

I want to make a couple of points. There is no study that actually looks at the size and weight changes that occurred in the fleet of motor vehicles in the United States as a result of fuel economy improvements, and their impact on safety. There is no such thing.

Instead what we have is studies of the safety of vehicles of different sizes and weights in a cross-section of the fleet during a certain period of time. We don't look at the evolution of vehicles over time and what actually happened, and changes that actually occurred to improve fuel economy, we look at a cross-section of the existing fleet.

So whatever's correlated, whatever other vehicle characteristics are correlated with size and weight, whatever driver characteristics are correlated with size and weight, whatever environmental characteristics are correlated with size and weight, unless we can adequately correct for those we're going to get spurious correlations.

So, in effect, looking at vehicle characteristics, we've been saying when you take weight out of a car you're going to make a five-passenger car into a four-passenger car; you're going to make a four-passenger car into a two-seater; instead of what actually happened, you change the cast iron into aluminum engine block; you change from rear-wheel drive to front-wheel drive; and you change from a chassis on a frame to a unibody construction, and so on and so on and so on.

So, those are the kinds of conclusions that the literature contains. Very very susceptible to spurious correlations.

I think that the majority view comes from 2001. They look at the individual situation. If I personally am in a larger heavier vehicle, should I collide with someone else I will fare better than the occupant of the smaller lighter vehicle that I may have run into, or that may run into me. And there's no question about that. The documentation and the scientific evidence on that point is very solid. The theory is very solid. We know why that's the case, and it is the case.

But that doesn't mean that if we downsize the entire fleet of vehicles that everybody will be worse off. It doesn't necessarily follow.

But it's very hard to overcome that sort of obvious personal viewpoint and look at this from a systems perspective. And I don't think that the safety community has done a particularly good job of analyzing that.

In fact, from a societal perspective

there's an externality there, which maybe you can see. If I buy a larger heavier vehicle I transfer safety risk from myself to you. Because if I run into you then you'll be worse. And unless my insurance makes me pay for the full cost of that, then there's an externality. And it doesn't come close.

The other assumption I think was the existing studies do adequately account for our spurious correlations. And the argument was that this latest study done in '95 by Chuck Cahane had done a good job in adequately accounting for those. And I just think that's not even close to being true.

And, in fact, there are other studies that we did not explain in the report that control much more carefully for these confounding factors. And in fact, sometimes come to opposite conclusions.

First of all there's no smoking gun. If you look at the light duty fuel economy from 1967 to 1999 and total highway fatalities in the U.S., there is no correlation between those two variables. You can add whatever other variables you care to into the equation. You can -- you must, of course, include a trend, the possibility of a trend.

But what really correlates with fatalities other than a time trend showing increase in fatalities is GEP, the higher the GEP the more fatalities; the lower the GEP, the fewer fatalities.

But there is no correlation with fuel economy of light duty vehicles. It's not even close. The sign is wrong that indicates decreasing fatalities from increase in fuel economy. And the statistical significance level is .65 suggesting that a two-to-one probability of getting that result by chance. There's nothing there if you look at it that way.

A lot of people, I said, in the past, this is all about the laws of physics. And the laws of physics require that heavier cars are safer. Well, here's where the laws of physics come from in this argument.

On the left side you have the equation that shows the change in velocity for car one colliding with car two as a function of the masses of the cars and the initial velocities of the two cars.

Why is change in velocity so important? Well, empirically the probability of a fatality increases with the fourth power of delta V. That is to say, well, this equation on the left can be rearranged to give you the equation on the right which says the delta V of car one versus the delta V of car two is equal to the inverse ratio of their mass, the mass of car two over car one. That's what the laws of physics say.

So, if car two, for example, is twice as heavy as car one, okay, then we have the ratio of the delta V experienced by the occupants of car one is twice that of the occupants of car two applied to the fourth power law, their probability of being killed is 16 times as high.

And the empirical data show this. There's no way around it. And that fits the empirical facts, as well.

But, suppose that I decrease the mass of vehicle two by 10 percent, and I decrease the mass of vehicle one by 10 percent, those changes cancel exactly, and there's no change in the delta V. That's why it's hard to get beyond the individual perspective on this, the societal perspective.

If you proportionately were to change

the mass of all the vehicles in the fleet, the laws of physics would tell you nothing will happen.

Now, this is a bit dense and hard to work through, but this is NHTSA's best study of this subject so far. And it's the only study that exists that considers not just what happens to the cars in collisions with other vehicles, but what happens to cars when cars collide with pedestrians and cyclists; what happens when cars collide with heavier trucks; and looks at the entire thing as a system and tries to analyze the whole question. The only study that does that.

What I put in the box here is just the crashes among highway users. Not the single vehicle crashes, but just the crashes among highway users. So I have everything from a car crashing into a pedestrian, to a heavy truck, to a light truck crashing into a pedestrian or a car.

And, I have a pointer, is it okay to go up and point to this, because I think it's very hard to explain without moving up there.

What I show here is based on the NHTSA model the expected percent change in fatalities for a given type of collision, here a light truck with a pedestrian or cyclist; here a light truck with a big truck. If I take 100 pounds out of the light truck, that's the way this model's constructed, so if I take 100 pounds out of a light truck and look at the effect on collisions with pedestrians and cyclists I would expect a 2 percent reduction in fatalities in pedestrians and cyclists due to the fact that my truck is now lighter, and smaller, by the way.

The study is very clear on the fact that it cannot separate mass changes from size changes, and so you're seeing the combined effect of both.

But, for that light truck colliding with a big truck, if I lose 100 pounds then I expect the fatalities to go up by 2.6 percent. And if it collides with a car, down 1.4 percent. If it collides with another light truck, down .5 percent.

So this says if I take weight out of the light truck and it collides with another similar vehicle, that the fatalities actually go down. Now, that result is not, in itself, statistically significant, although the whole model is.

Okay, so then I put over here the total fatalities of that type occurring in the year when the study was done. And so over here I get, by multiplying these numbers together, a change to the delta fatalities, associated with taking a certain amount of weight out of the light truck.

Except I'm not taking 100 pounds out of the light truck and 100 pounds out of the car; I'm taking 10 percent of the weight out of the passenger car, which is 338.6 pounds, and 10 percent of the weight out of the light truck, which is 443.2 pounds, and seeing what the impact of that is.

A very interesting thing happened. The collisions with light trucks, by taking that weight out of the trucks, I get a reduction of 451 fatalities, according to the model.

Taking the weight out of the cars I get an increase of 467 fatalities according to this model. And the net result is an increase, expected increase of 16 fatalities, in collisions among all highway users, with -- of more than 100. In other words, don't know, zero, the model can't tell you whether there will be an increase or decrease.

The other interesting thing to note is that even though the conclusion of -- and that's consistent with the laws of physics. But it may not be right, it may be right. And this is the model that the National Academy committee used to predict its 1300 and 2600 increase in fatalities.

So where did they get the increase in fatalities? It's all from single-vehicle accidents. It's all from rollovers and fixed objects. And that's very interesting because there isn't any inherent reason or any laws of physics that tell you that there should be a relationship between rollover propensity or performance in a collision with a fixed object and the mass of the vehicle.

In fact, if you look at light duty vehicles and it's a static stability factor, which is empirical measure it's twice the height and center of gravity divided by the width of the vehicle. They believe it correlates very well with the propensity to rollover.

If you look at that factor, and furthermore, it's the vehicle characteristic only; has nothing to do with the driver; has nothing to do with the environment.

If you look at that you see that the stability of the vehicles actually decreases.

Rollover propensity increases with weight of light duty vehicles.

Well, it turns out that that's just because of trucks. You separate the cars and the trucks, there's no relationship between static stability and mass of cars, and there's no relationship between static stability and mass of trucks. It's just that trucks are designed to be less stable. So it's a matter of design.

If you look at NHTSA's five star ratings for vehicles as a function of the mass of the vehicle, you find that there's no correlation with the crash performance of the vehicle on NHTSA's head-on crash tests as a function of mass, whether it's for the driver's side or for the passenger's side.

Why is that? It's not about mass. It's about how you decelerate the vehicle in this crash, how you protect the occupants; how you absorb the energy; what materials you use; and how you design the vehicle.

So, when I look at this issue I think we've sort of got it backwards. We're looking at effective fuel economy changing the mass and weight of all vehicles, which is a very very complex issue. And I think the best of our knowledge at this point is inconclusive.

It may be a benefit. It may be harmful. And ignoring the fact that we have a huge problem in the disparity of weights of vehicles on the road in the first place.

Joksch, for example, has done some very good work on this subject. He found risks imposed on lighter vehicle occupants by the occupants of heavier vehicles exceeds the benefits to the occupants of the heavier vehicles.

Well, that's sort of consistent with what An founded in his analysis, although that wasn't statistically significant. And Joksch found that it was the distribution of weights that was the big problem.

And a very recent study by Alexander Kuchar at Volpe Center found that if you just look at frontal crashes, whether they're vehicle-to-vehicle crashes or crashes into fixed objects, that taking a fleet of 100 percent passenger cars, this was done by simulation, and shifting it gradually to 100 percent light trucks, just uniformly increases fatalities. This is sort of contrary evidence that the committee didn't pay any attention to.

That's not to say you can just ignore this issue and say, okay, it doesn't matter, completely ignore this issue. No. It's just more subtle and more complicated. Because if size and weight are changed, there are going to be winners and losers. You lose when you run into a heavy truck; pedestrians and cyclists will win if you run into them. Or maybe you won't run into them because you've got a smaller line of view. But, anyway, they win.

And we also know that if you're going to make significant fuel economy improvements, 50 percent or so, then you're going to redesign all of the vehicles in the fleet in fundamental ways. And anytime you redesign vehicles fundamentally safety is an issue.

But the idea that there's a necessary tradeoff between fuel economy and safety is not correct.

So, thank you very much for your attention, and that concludes my talk.

(Applause.)

MR. FONG: Okay, we have our next speaker, and it's Mr. K.G. Duleep. On your agenda, if you noticed, we had another speaker who was going to provide us with a summary of a study that was done by the American Council for Energy Emission Economy. Unfortunately, because of all the travel disruption we've all been experiencing, Mr. An is not able to make it. So, Mr. Duleep.

MR. DULEEP: Thank you, ladies and gentlemen, thank you for having me here. I'm honored to testify before the Commission.

What I'll talk about is built off Dave Greene's topic on the National Academy study.

A lot of you are interested in I think one of the questions that was put to the panel that was what is going to happen in the future. And I'm doing the bad thing of replying to the question with another question. You'll have to tell me what the future looks like in order for me to tell you what cars are going to look like.

Because literally what happens to fuel economy in the future depends on a lot of things. It depends on obviously what you think will happen to the price of gasoline. And also very strongly to the economy conditions.

I think we've heard a lot of people say in the last 10 or 15 years that mpg has stated their plan and all of the technologies has got their attributes, and obviously there's a reason for that. It's because the stock market, the Dow Jones went from 2000 to 10,000, and the NASDAQ went from 1000 to 5000, so it put a lot of money in people's pockets. And when people feel rich they buy bigger cars; they buy more luxury features; they buy higher performance vehicles.

And I think that's not widely recognized. In other words there's a general feeling if it says black in the last 15 years, it's going to stay black the next 15. And that's just not a truism, I think.

I think that what we will see will depend very much on what you think will happen to the state of the economy, and what you think will happen to gasoline prices.

As Dave Greene pointed out, there's a lot of technology that can be introduced. And there's no question about it. And clearly, how you extract the benefits of technology as a society is what the whole issue of trying to forecast the future comes down to.

Again, I think that these issues are actually harder than technology issues. In other words, how is the consumer going to behave? What is the NASDAQ going to be in five or ten years? I think all these factors are very interesting determinates, though, for what happens. But those actually are harder to predict than the technology, itself.

And lastly, a lot of the work at the National Academy, this is a topic that they didn't mention or that's not commonly mentioned, is of course, they know how to give you that, but for only to keep it as a vehicle constant.

So, there is this tension that is underlying and explains why the auto companies, et cetera, are against these standards, is that people want their next car to be better than the last car they had. Or if they get richer they just want more cars.

And so these are things, I think, that are very strong and very powerful determinants to what could happen.

I did want to talk a little bit about potential consumer response. One of the things that you hear, and this has been a regular drum-beat, is that the average consumer doesn't care about fuel economy. And you hear that a lot of places, in surveys, it went down from, you know, one to like 18 and number four back in 1980. And it's now, you know, like not on the list and so on.

And one of the things that we did do for the National Academy is we took all the cars out there and grouped them by size and performance into very homogenous classes that say, you know, the close competitors.

In other words, if you were shopping for a car you would go out and choose among this particular set of cars. It would be logical sense for you to choose from.

And I'm just not going to show you all the details, but what emerges is actually quite interesting. I'll be showing you data on three sets of cars, okay.

One is compact. These are all pretty large classes in terms of sales volumes. And there we see the Toyota Corolla and the Honda Civic, around 37 miles per gallon, give or take a half an mpg. And the best is down around 31 or 33.

Take a look at the mid sized. The Camry and the Accord are about 30 mpg. The rest of the competition is -- there's a typo on there, that's 6-9. The rest of the competition is about 27.

Take a look even at luxury cars. The Mercedes E320, you know, mid sized car, is at 27.6, also number actually. And the rest of the competition is down at around 24 miles per gallon.

Now, the bizarre thing in all this is in every class that we looked at the best fuel economy cars were the best sellers. And here's this situation where everybody's saying the consumer doesn't really care, and yet you have a situation where Toyota and Honda -- fuel economy and they're, you know, they're going gangbusters. Toyota and Honda have gained market share every year in the last ten years.

And so this is a very strange phenomenon that you have, people actually saying that are now perhaps in surveys that they don't really care, but buying cars that actually emphasize fuel economy and not by small margins. Toyota and Honda typically do about 10 to 20 percent better than new cars in that segment. And the same is true for Mercedes, selling extremely well.

So going back to this particular slide, I just didn't show all the classes -- now, what's interesting is that you don't see that in light trucks, largely because first, there aren't as many import models. There are very few; the imports just started coming in.

But I think you'll see a similar, I think this is the last year or so you had a whole bunch of SUVs from Toyota and Honda. And so we don't see that correlation in light truck classes.

So I think in my mind if I look at this data, sure, consumers want a lot of things. They want size, they want performance, they want comfort, they want reliability. But to say they don't want fuel economy refutes what I think the market has shown

Here we are seeing people actually willing to pay extra. I know all the arguments that you guys are formulating in your head. I've heard them, you know. They buy Hondas and Toyotas because they are more reliable, they're good cars, this and that.

But part of it is fuel efficiency. I'll offer that to you. That, yes, of course, these are all true. People don't buy for a single issue, but clearly fuel efficiency is something of value. You don't see a fuel inefficient Honda.

Let me just bring up a couple of issues as I go on. When I showed you the technology stuff that is under cost of attributes. That's really the only way you can do technologies, is first you see what the benefit is, if you keep the rest of the cars attributes constant. By which we mean the interior room, acceleration and passing performance and power and safety features. Obviously you take the technology benefits.

The other difference, and this is something that, you know, perhaps people are -- and so on, is that Canada and the European community use fuel consumption, use fuel economy. The two are not the same.

A 33 percent improvement in fuel economy is a 25 percent improvement in fuel consumption and so on and so on. So one thing worse than the other; it confuses a lot of people.

The second issue that we often run across is this issue of cost and price. Sure, we know things cost something. Something probably costs $5; you go buy it at the factory in China; by the time it comes here it's $15. And that's the same effect in cars. That is supplier costs are not the same thing as retail price.

And so one of the things we want to emphasize is that we talk more price rather than costs, or costs to the consumer. And I think that that's where you see some, more people talk about.

Lastly, I'm supposed to be speaking again this afternoon, and so in this talk I'm focusing only on sort of the nonhybrid, non-fuel cell technologies.

I don't know how many can read this; I apologize for the fact that this doesn't seem to be focusing. But, if you look at what technologies are there, there's what I fundamentally classify is low risk technologies, stuff that's being done are there. Stuff that's already in production in a lot of cars.

And medium risk technology which are things that are on a few cars but not widespread.

And the list shows you that the technologies, weight reduction, there's drag reduction, there's a bunch of engine improvements, many of which are happening as we speak. There's different types of, you know, many more gears and automatic transmission from four speeds to five speeds, and maybe to six speed manuals and so on. There's improvements in tires, lubricants and all this.

Once you combine all these into a vehicle there's a fair market benefit. You certainly can go further, especially in engine technologies. Among the things in engine technology is cylinder deactivation, variable valve lift and timing, and gasoline direct injection, which is a lead work; an advanced technology that's very popular in Japan, and is coming out all over Europe.

And we looked at all of these and I do want to point out that Dave Greene showed you some aggregate curves of costs versus fuel economy, and they all seem to fall in a fairly -- but strangely enough, the sense of technologies that go into those curves are not quite the same.

The NAS study, for reasons relating to perhaps the composition of the committee, focused much more on drive train technologies and found a far more optimistic in drive train technologies than we got when talking to the manufacturers.

One of the things that we did do as far as the NAS was to visit and talk to many of the world's leading manufacturers.

Since David has made a big case for the

fact that weight reduction doesn't necessarily cause fatalities, we did go to Europe and had very very interesting presentations on major national for both Audi and Porsche.

And one of the things that is happening in weight reduction is that Audi, I think many of you know that Audi came out with the all aluminum A8 back in the mid '90s. And now there's a new car called the A2, which is a very small car that just came on last year.

And one of the things that they did find is it's a very steep learning curve. As with any new technology you don't know how to make it until you really start making it.

And they admit that the A8 was practically hand-crafted, and they had like ex-- from Bavaria welding these things --

(Laughter.)

MR. DULEEP: -- and so on, but like now, the A2 is moving towards more mature type of processes. And they see what they're learning in this. And there are cost differences, and in the literature of what aluminum bodies might cost, and so on. And some of it is, in fact, associated with what you think will happen in the future in terms of how you may do the construction.

There are some very interesting differences between Japan and the U.S. and perhaps Ben Knight can address that. The designs for the aluminum vehicles and the Europeans -- and, of course, each company denigrates the other and so on. But obviously there is a lot of intense competition going on with them. The idea is tremendous.

The other very interesting thing that we found was that Porsche has been doing work with steel manufacturers. And they have what's known as ultra-light steel body concept. And that suggested that Porsche thinks that using very high strength steels, the kinds of steels that are coming out now, will push steels to the point where they'll be almost as competitive as aluminum in reducing weight. But at a much lower cost.

So it was a fascinating presentation. We got comments on that presentation from other manufacturers about that Porsche had most of their facts accurate, perhaps there was a little optimistic in some things, but the basics of the presentation were that, in fact, it is possible that steel can be a lot more competitive than what people think today.

And so here are technologies that are essentially moving forward, even as we speak, and reducing costs to levels that were perhaps not believed a few years ago.

Here is the new Audi A2. That's not very focused at all. But, Audi showed us this graph that compares the A2 to their competitors. These are cars that are very similar in size to the A2.

And what we see is that on average there's something like a 20 or 21 percent weight reduction relative to the competition. So it's a very sensible weight reduction that comes out of using a very aluminum intensive frame type structure.

And incidentally, the Audi A2 is one of the few cars in Europe now that gets 80 miles per gallon, or three liters per 100 kilometers. It's -- small diesel engine. It's, unfortunately, a bit of a dog on the highway, but other than that it's --

(Laughter.)

MR. DULEEP: But, you know, you can't have everything. On the aerodynamic front, too, we had very good agreement among manufacturers of all kinds of numbers are possible. We saw values that suggested drag could be reduced down to maybe .24, the coefficient of drag; which is a typical number which they start maybe .32 and go down to .24 or .25.

And, you know, there's a common belief that on a very small car you can't get good aerodynamics because you don't have enough length to smooth out the air flow. And the Audi A2 is at .25, at least according to Volkswagen.

So I think the popular idea that the very small cars can't get good aero is certainly the future for the production car today.

Moving on to the conventional spark ignition engine technology. The three things that are going to happen and have already happened with some of the manufacturers is one is called variable cam phasing, which changes the timing of the valves. A lot of people have started using that recently. Just in the last few years I think GM's got the new straight six engine in their trucks; Ford's had it for a bit; Toyota and Mercedes has it on practically all their cars.

That gives you a small benefit but it's

very very cheap; it's become extremely inexpensive. And we've seen other things like variable valve lift and timing. Honda is the leader in that technology. And we're seeing advancements to that technology. We see that as probably the next step that will happen.

And then the biggest thing that's happening, and will happen this fall in all the Mercedes V8 engines, is the cylinder -- it's like the old Cadillac V8, 6, 4, except it works better. And, in fact, the Mercedes engineer gave me the car, drive it around -- how many cylinders it was operating on, I couldn't tell. It's that smooth. You can't notice the difference between when you're running at 4, 6 or 8 cylinders.

The manufacturers think that you can't do it with anything less than a V8, because otherwise you're going to be seeing imbalances. So that tells you how much technology advancements there can be.

The last major technology I talk about before wrapping up is the direct injection engine. The gasoline direct injection engine is a lean-burn technology. And there are some companies that have invested heavily in it, Mitsubishi being one.

And typically produces something like a 12, 13 percent benefit. Manufacturers argue about the exact number, especially because of emission standards. And as with other leading technologies like the diesel, the only big problem is trying to meet these very low levels of emissions, like the emissions mandate in California.

What we did here in Europe is that at low mileage manufacturers had met the LEV II standards, the Tier 2 and LEV II standards. What they are concerned about is the durability requirement. California requires that you meet these standards at the end of 120,000 miles. And they're having a hard time doing that, especially with the U.S. quality gasoline and U.S. conditions.

Volkswagen gave us this piece of information on their NOx trap for the GDI and you can see that they're about 100,000 kilometers, 60,000 miles certification for Europe, and the NOx trap runs at 97 or 98 percent efficiency right through, right all the way down to the 60,000 mile mark.

So there's hope that the 120,000 mile

durability in the west can be met in the future.

Before I go I should also say a brief word about diesels, which is a bad word in California, but a good word in Europe. And the only explanation I've heard for why Europeans like diesels is from -- some of you may know, he believes that most Europeans also smoke, drink and eat red meat. And if you have all the toxins in your body that the diesel particulate doesn't get to you.

(Laughter.)

MR. DULEEP: So that's why diesels are widely popular. So the problem is you guys don't smoke enough, so.

(Laughter.)

MR. DULEEP: But the big thing, of course, is that on a per-car basis, regardless of what Lee Schipper said about driving more, or a per car/per kilometer basis, diesels are very efficient. No question about it. You can get 42 percent better efficiency in a single shot, one technology that gets you the entire benefit.

And a lot of issues about whether future LEV II standards can be met. The recent data again shows the same issue as with the gasoline direct injection, that is that low mileage. Manufacturers think that might be done. At high mileage they think that they're very concerned. They don't know about the durability effects, et cetera.

And my prediction is yes, probably by the end of the decade they'll have enough technology to meet this. But that's just a prediction, not something that's being done to date.

Let me quickly close with showing you some of these break-even analyses -- okay, let me just show you the summary of evolutionary potential. That just based on the work we did for the NAS, one of the, I think, major contributions that the NAS made that David didn't say was that the old days were wide disagreements about what technology -- $30,000 and it can't be done.

And I think one of the wonderful things that has happened as a result of the NAS study is that that kind of disagreement is now gone. Most of it, I would say plus/minus 10 percent range. And that's been a major help to the community that, you know, you don't have to go through these types of very wild differences in estimates.

The other issue is which of these technologies that I'm talking about will happen. My own feeling is that a lot of what I call medium or lowest technologies are going to happen on their own regardless of what the regulatory climate is. We see that happening already.

We see that happening as Toyota and Honda put the technologies to use and manufacturers have to compete. And we did just a hypothetical, like you take a Ford Focus and keep adding all these technologies and what happens to it.

And it turns out that even if you assume gasoline costs $1.50 a gallon, and most consumers want to be paid back for anything extra, fuel economy in four years. You can see about a 20 percent improvement in fuel economy with a four-year payback. In other words, if you keep it longer the less the fuel economy.

And if you look it on a life cycle basis, over the entire life of the car, then maybe you can do about 33 percent improvement in fuel economy.

And just to give you a feel, the Ford Focus is currently about 35 mpg. And which means that the 20 percent -- about 42 mpg, and 42 mpg, incidentally, puts you about where the Civic with the CVT gets today.

And so it shows you that, you know, the stuff that's out there in the market is actually stuff that can pay for itself in the future.

And on the life cycle basis you get up to some technologies which are what I would classify as medium risk may or may not happen.

Now, I did tell you that all technologies stuff does not constitute attributes. And the issue here is that, okay, you can get 20 percent if you keep the attributes of the car constant, but are attributes that will be constant. That I mentioned, as I mentioned, is the function of the economic scenario.

But if you think about moderate economic growth, people do get richer in the future, I would assume that a more constant 20 percent will be lost to people buying more car. In other words, the car is just nicer, faster, whatever.

And the other issue is that if some things like gasoline direct injection eventually cannot be used, if standards keep getting tougher and tougher, as Paul Levin has indicated, you might lose another 4 or 5 percent.

So, you could see scenarios in the future where even under a nonregulatory flat fuel price scenarios, even under no new regulations fuel economy does go up, and we think it will go up in the 10, 12 percent range over the next say by 2015. But obviously if things change in terms of either the economics, you apply economics to the scenario you could go much higher or much lower.

Thank you.

(Applause.)

MR. FONG: Roland. The next speaker will be Roland Hwang representing the National Resources Defense Council.

For those looking at your watch we are running a little bit behind. We will make every attempt to close this session at around 12:30. And then start up the panels in the afternoon at about 1:30.

And for those of you who are out of town we have provided a list of local eateries which is on the table out in front. So, we're going to get you to lunch.

Roland.

MR. HWANG: I think Dan misspoke slightly; I'm with the Natural Resources Defense Council, not the National Resources Defense Council. You're in good company because there was a press release by the Governor's office a week ago announcing a colleague of mine, Peter Miller, appointed to the CO2 -- where they also got the name wrong. And something we just comment, so you're in good company, Dan, but it is the Natural Resources Defense Council.

NRDC, hopefully most of you are aware we're a national environmental group and I've been doing some analysis and studies of how the cost benefits for reducing California's petroleum dependency.

I did make one little error, I think -- my presentation. I did an animation. That means I'm going to have to touch the screen quite a bit, more than the other presenters. So bear with me if it takes a little bit longer to get this right.

But I think one of the important things that we feel is that California is at a cross-roads in our transportation energy future. I think for a variety of reasons this is a good time the state agencies, the Energy Commission, the Air

Resources Board and others, to consider plotting a different kind of future than we are headed for, which is high demand, out-stripping our in-state refinery capacities, one of the most critical issues in our transportation energy system.

But, of course, we're going to be increasingly dependent upon imports, refined products, gasoline, diesel, jet fuel. Increasingly dependent upon imports of ethanol, which adds another dimension to our vulnerability of our gasoline supply.

So I think we're all expecting to see increasing petroleum price volatility. And the Energy Commission, itself, has estimated increasing price volatility starting as early as next year, perhaps in the range of 50 cents a gallon as you phase our MTBE and phase in ethanol.

Clearly it was required to pass. The Energy Commission again, has spoken about and written about in their California energy outlook of the increased frequency of refinery outages. The refineries are running at essentially full capacity, an incredible strain on our system.

And finally, I think the recent events do remind us of the increasing volatility in the global oil market is something that we should be expecting.

We do believe that petroleum dependency is an essential component of a balanced and responsible transportation energy strategy both here in California and at the national level.

This is something the state has long recognized the importance of reducing petroleum dependency. And when I say reducing petroleum dependency, both reducing the rate of growth in demand for petroleum, and also increasing diversity of our energy supply system.

And there's a long history. Back in 1991 there was something called SB-1214 which mandated the California Energy Commission Staff here worked on, something which was developed in order to try to help provide analytical guidance to how to better structure our petroleum markets, provide least cost transportation services to our state.

And the study wasn't completed, but I think unfortunately we see the trends that 2 percent growth annually and 20 percent growth by 2010. Unfortunately we have not been doing much over the past decade, and quite the opposite, in fact, losing ground in terms of implementing the intent of SB-1214.

And finally, I served on, along with John White, as many of you will know from the environmental community, we serve on a gasoline price task force which was put together to address price volatility that California has experienced in the last several years.

And, of course, the AB-2076 was one of these legislation which resulted from the gasoline price task force. Again, both of these, both the gas price task force and AB-2076 recommended reducing petroleum demand as a mechanism to address the increasing gasoline price volatility due to the nature of our supply and demand situation.

The goals of a balanced and responsible transportation energy strategy, which we currently do not believe we have in the state or nationwide, basically result least cost transportation energy services. And, again, we believe that one of the goals of that is to minimize the health and environmental impacts of petroleum consumption.

And we should also be looking at, of course, integration with some of our other policy goals, some of which do not necessarily fit neatly into a cost effective framework. I think clearly those of us who have studied a little bit of economics theory realize the issues of equity, environmental justice, those kind of issues are not captured in the traditional economics type analysis framework.

So we believe that from the principles which we're urging the Energy Commission to adopt in its analysis, in its recommendations, is a comprehensive accounting, all environmental and other socials costs associated with transportation, and a full fuel cycle of wellhead to wheel bases.

We believe that it must be absolutely part of this study that we must recognize that we are facing many challenges as are related to the way we use energy in this state, including meeting air quality goals that they have. Paul Wuebben spoke of this. We are in a situation where we're searching for every last ton of emission reductions, and -- requirements.

That is to say the implementation plans, particularly the San Joaquin Valley Air Basin. We are well short in both reactive organics and nitrogen oxides. And petroleum benefits of reducing petroleum dependency, reducing consumption, switching to -- fuels must be part of that comprehensive strategy to meet the air quality standards.

But other environmental, health, environmental justice type goals, we have issues there. Toxics, we have issues of localized air pollution affecting communities, just to name a few.

The study should also recognize that we need strong incentives for innovation. I think that David Greene spoke of some of the differences between the NAS study and the MIT study, which is that when you look at a snapshot of where technology is at right now, that that doesn't fully encompass what we promote we know has occurred over the past in technology innovation.

And, again, California has been a leader in pushing the innovation in motor vehicle technology and appliance technology and building standards. So we have demonstrated it can be done and part of this study should not be looking at snapshots of where we think technology is today, but clearly be pushing towards innovative in the right manner.

We've covered this. Just from the NRDC's perspective, again, look at a comprehensive strategy that includes increased gasoline fuel economy, fuel switching, advanced technology vehicles and reduction in travel demand.

You know, I'm going to talk today about the first measure, which is increased gasoline fuel economy. And others will be talking about some of the alternative fuels, advanced technology vehicle issues.

Tomorrow a colleague of mine, Donna Liu, will be talking about smart growth in general, and in particular, location efficiency mortgages.

Clearly there's a large untapped potential for fuel economy increases. And, again, that's David Greene and K.G. Duleep, I think, covered this very well. Studies by ICEEE, DOE, which we believe actually is the primary technology numbers from K.G. Duleep, MIT and the National Research Council, and the National Academy of Sciences, of course.

We looked at a recent study by ACEEE, which as David Greene mentioned in his study, they are the probably most optimistic numbers that we think are realistic.

And when you look at it the fuel efficiency measures, from a technical perspective, obviously look very very attractive. And it's just a study you look at will lead you to believe how attractive the fuel efficiency rating fuel efficiency is.

But there's no doubt there's tremendous potential on the technology packages that ACEEE looked at, would potentially pay the consumer back over about a five-year period at equivalent gasoline price of somewhere between 70 and 80 cents a gallon. So, that is obviously a very attractive deal for consumers and for society.

But when we took a look at, we developed a scenario for future energy demand, and this is basically the California energy outlook. It's slightly different because we're looking at just half a year vehicle rather than total gas in demand. This is basically calibrated to the latest Energy Commission forecasted demand, 20 percent increase by 2010, of 40 percent by 2020.

And we looked at several scenarios. One is closing the STD loophole following Dianne Feinstein's bill, which would raise light truck fuel economy to 27.5 from it's current 20.4.

And we looked at a couple different scenarios where we would raise fuel economy of the California passenger vehicle fleets to the moderate technology level, 36 miles per gallon by 2015, starting in 2006, over a ten-year period. And to the advanced technology level.

So what we can see from this graph is that from fuel efficiency alone we can, over a two-decade period, the cost effective fuel efficiency alone, we can return our energy dependence back to today's levels through cost effective implementation of new vehicle technology.

So, reduced gasoline consumption is up to 7 percent in demand by 2010, which is a 14 percent increase over today's levels through fuel economy. But a 28 percent reduction by 2020, which is essentially only at level, at 2000 levels. And over that two-decade period that advanced technology scenario, starting 2006, raising to 41 miles per gallon in 2015 is the equivalent of the output of five average sized California petroleum refineries.

Obviously the reduction in the

infrastructure needed to supply all that petroleum, increased petroleum demand will result in direct air pollution and health benefits. We see that reduction in criteria air pollutants and air toxic emissions from upstream sources, or equivalently, you know, avoid the need for additional controls, all these measures, because from our perspective, of course, we are not going to hold up progress with regard to air quality goals.

So, we estimate 10 tons per day by 2010, up to 45 tons per day of smog forming pollutants, hydrocarbons plus NOx, would result from that 41 miles per gallon advanced scenario.

Reductions in greenhouse gases of 400 million metric tons of CO_2 over the two-decade period. And there also we would expect to see reduction in groundwater contamination and oil spills, among other benefits.

Direct consumer savings, which is the net of the fuel costs minus incremental vehicle costs, $12 billion for the two-decade period.

Other economic benefits which are more, some of them are more difficult to quantify. We believe the Energy Commission should recognize them and quantify to the maximum extent possible in their study, would be avoided pollution control costs; a boost to California's economy from the cost savings, returning money to the consumers' pocketbook; reducing demand pressures on petroleum supply system; and it would help to reduce the frequency of price spikes, as noted by the attorney general's gas price task force. And the reduced impact on the economy of reducing the gasoline price volatility is another benefit to California.

There are things which California can do obviously, from the environmental community's perspective we'd like to see the federal government take leadership and take action on this issue by raising the fuel economy standards.

But we believe that California does have a role and traditionally has been able to effect technologies and lead the country and lead the world by developing new technologies that benefit the environment and our energy policy.

So, we believe that we should be implementing a green vehicle market transformation program, elements of which we see can be purchase incentives for clean and efficient vehicles.

Current proposals would include, we saw this last legislative session, a bill AB-554, by Assemblyman Campbell; we also saw AB-321 Vargas. The Campbell bill, I believe, is a two-year bill now; and the Vargas Bill, I believe, did not get out of the state legislature.

We do recommend incentives. If the incentives are limited by a Campbell or Vargas type program, that they be targeted at clean and efficient vehicles.

And we also recommend, of course, that we move forward in adopting broad base incentives such as feebates and pay-at-the-pump insurance.

The other components of green vehicle market strategy would be fuel efficiency standards. Again preemption on motor vehicles, the tires. That's in a bill called SB-1170, which is now on the Governor's desk. Development of a fuel efficient tire program. We would hope that would be some vehicle, replacing the tire labeling standards. A very cost effective measure; a less than two year payback time is likely if replacement tires are as fuel efficient as the original tires.

Green fleets. SB-1170 again would

require the state to take leadership on purchasing fuel efficient tires and vehicles. That's the first step in leadership. But we also hope that we can expand fuel efficiency for fuel consumption reduction program to public and private fleets in some manner.

Public and consumer education I think has got to be a vital part of all of this. Current projects, the Energy Commission has the fuel efficiency incentive pilot project; and the ARB has ZEV public education program. These, I think, are both critical seeds to a broader effort to educate the public and affect consumer decisions.

We definitely support some sort of green vehicle labeling program based on an integrated class rating system like the ACEEE green vehicle guide. We do not support the EPA's current green star approach. And, you know, the South Coast program, that's a good step forward. We think the South Coast green vehicle approach also include gases or energy consumption in some manner, in an integrated manner.

Another recommendation is that we need to harmonize our air pollution and energy programs. I think it's pretty critical for any pollution and energy goals we're going to have to harmonize them to enhance the effectiveness and lower cost.

Again, we are very much challenged by the current air quality situation in California to find additional tons to get us into attainment for federal air quality standards by the deadlines.

Air quality and energy harmonization policies would include, when we have listed incentives, target those to the super clean highway fuel efficient vehicles. That would be as defined, our recommendation by the advanced technology PZEVs and pure ZEVs under California's program.

We recommend California regulation of motor vehicle global warming pollution as another two-year bill, AB-1058, Pavley.

Finally, we believe that the state implementation plan for ozone attainment should include some measures of upstream air pollution and air toxics, reduce those, put some responsibility on the end use.

Other programs to harmonize. We have to look at, of course, our water quality, land use planning and transportation infrastructure funding and environmental justice.

Again, it's critical that we get as many stakeholders involved, because everybody has a stake in reducing petroleum consumption. Auto dealers, environmental groups, automakers, federal and local governments enhance green vehicle efforts.

Voluntary fleet efficient of petroleum reduction commitments. That automakers and private and public fleet owners can get involved in.

And public education to change behavior. That could be a natural kind of partnership with the oil industry, auto clubs and others.

In conclusion, we believe the state cannot meet future increases in transportation energy services while continuing progress towards health and environment demand without reducing rate in growth in demand for petroleum.

That's quite a mouthful, I don't know if I quite said that as cleanly as possible.

State transportation energy strategy should provide transportation energy services at least cost to society. Which we are clearly not even close to at this point.

To protect the environment and the economy, the state should adopt policies that insure the maximum cost effective reduction in petroleum dependency, as supported by AB-2076 and SB-1214 and the attorney general's gas price task force.

And finally, in terms of goals, we believe the state should, at the minimum, and over a two-decade period, adopt a goal of return to 2000 levels. This can be done at net savings in private costs alone.

If we include -- we have not included in the study at this point advanced technology vehicles, both hybrids and fuel cells. We have not included cost effectiveness other measures, including alternative fuels and VMT reduction, vehicle miles traveled reduction, programs.

When you have those I would assume that the goals should be even more aggressive than what we have here. Again, over a two-decade period, returning to 2000 levels is very do-able. And it can be done at a benefit to our economy.

Over the median term 2010 we are looking at it from our study, 14 percent increase from

2000 levels. And again there are a variety of other options, I think, available to us to reduce that even further.

Finally finally, we believe it's very important, and one of the reasons why we included the California Air Resources Board in the AB-2076 study, the Air Board and the Energy Commission do a study jointly, was because we believe it's absolutely essential to protect our economy, meet our environmental and public health goals, that we must harmonize our air pollution and energy policies to the most cost effective, efficient, expeditious meeting of all our goals.

And, again, our goals are very challenging, extremely challenging. And it doesn't benefit any agency or any goal to implement programs which do not make maximum advantage of the synergy between -- energies between programs.

Thank you for your attention, and we look forward to working with the Energy Commission further on this study.

(Applause.)

MR. FONG: Our last speaker is Steve Douglas representing the Alliance of Automobile

Manufacturers. Steve, I hope you don't feel like you're carrying the full burden of the private sector here. I had hoped to have representatives from GM, Cummins and Toyota, but again, they were all disrupted by the travel problems.

So, let's see if we can load up your file.

MR. DOUGLAS: While we're getting ready, I appreciate, first of all, I'm left with a leisurely three minutes to finish this presentation. It's always a pleasure to be the last speaker before lunch.

Okay, and I will, I'll try to go through this as quickly as possible. What I'd like to do, I think, is just to outline some of the things I'm going to say so that I can flip through the slides fairly quickly.

First thing is I'm going to tell you that today's vehicles are the most efficient as they've ever been in history. And so you might think, well, why then is petroleum consumption continuing to increase.

Well, the answer is that the vehicles are more efficient, on a pound-for-pound basis, vehicles have become more efficient, and they've been becoming more efficient each and every year, about 2 percent efficiency gain every year.

However, there is a tradeoff. Vehicles today have significantly more features. The size is an element. Their performance of vehicles is better today. The comforts, both in terms of internal and external comforts, emission controls. All those have an impact.

And finally, safety. Safe vehicles would be the air bags, to numerous safety, both requirements, those that are mandated, as well as those that are voluntary. The safety issues that consumers want. So that's from the vehicle side.

The second thing is more VMT. VMT is increasing. In fact, since 1969 VMT has increased 55 percent. From roughly 8500 miles per year to roughly 13,000 miles per year today.

Finally, passenger vehicles aren't the only consumers of petroleums, so there are a number of sources out there.

So there's a number of --those are the reasons that the presentation focuses on.

In addition to this there are some significant changes. I was talking with Susan Brown earlier, there's no simple solutions here.

If there were, we'd have made them years ago and we wouldn't be standing here today. It's complex.

But there's probably never been a time in the industry more exciting with more changes, more fundamental changes to technology.

So, with that, the Alliance numbers 13 automobile companies, most of the major automobile companies in the world.

These are some of the facts, these are some of the things that I hit on before. Larger vehicles require more energy to move them. I've heard a lot of reference to SUV loophole. That's not a loophole, that's a fact. That's a fact.

The second is that Americans drive more when the price to drive is lower. Again, that's just a fact. If you lower the price to drive, people will drive more.

Vehicle fuel efficiencies are the highest they have been at any point in history. As far as the CAFE and as far as the fleet fuel economy, it's determined by what people buy.

This is just a summary of the CAFE rules. It's obviously a harmonic average of both the city and highway, highway miles. There's a penalty associated with CAFE, $5.50 per tenth of a mile per vehicle.

Consumer purchase reasons. I think this has been highlighted, but there's a number of reason people buy a car, including if everything else is equal, the highway fuel economy is better. There's no question about that.

But everything is rarely equal. And here are some of the things that people look at when they're buying a car. And these are listed in the order of preference.

Fuel efficiency is decreasing. This is obviously -- this is obviously a myth, this is not true. On a pound-for-pound basis fuel economies or fuel efficiencies have been increasing at about 2 percent per year. And here's a graph of that. And it has been increasing for both cars and trucks.

Here's some of the additional features that consumers are demanding. Air conditioning, that's obviously a big one. Air bags, in addition, again, air bags.

And so what we have, I just wanted to show or demonstrate some of the changes that have been made, some of the progress in some of the vehicles.

Here's a 1978 Dodge Omni. Compare that to the 2001 Chrysler Concorde. The Concorde gets better fuel economy, yet it's significantly larger. The emissions are 95 percent less. And, again, the fuel economy is higher.

Here's a 1990 BMW325i. Fuel economy combined, 20 miles per gallon. The horsepower and torque. Here shows a 70 percent increase in fuel economy in the city; a 30 percent increase in highway. The horsepower is 34 percent increased. And, again, the emissions standards are 95 percent lower than what they were.

And finally, a Toyota Corolla, that compared to 1990 with the 2001 model year vehicle. And, again you see significant increases in the fuel economy at the same time with the horsepower and torque are increased.

The next myth: Automakers don't build fuel efficient vehicles. Again, there are numerous vehicles out there, over 25 light trucks that get more than 25 miles per gallon, Over 50 passenger cars that get over 30 miles per gallon. So the vehicles are out there.

And so I think, and this will be in the recommendations, what we have to do is bring the consumer into this equation. We have the vehicles, the fuel, the government; now we need the consumer.

And, again, there is all this discussion of what other countries do. But I think it's worthwhile to note some differences, and I think most in this room understand this. The cost of fuel in other places, Europe, Japan, is substantially more.

The technology penetration for the other technologies such as diesel is substantially different; much higher in Europe and Japan. Vehicle miles traveled, again, and this harks back to if it's cheaper to drive people drive more. And sure enough, it's more expensive to drive in Europe and Japan, and they drive less. In fact, about what we did in 1969.

And finally just so that everyone's aware, when you look at fuel economy, reported fuel economy from other countries, they don't use the same testing methods that we do. So there would naturally be a disparity between fuel economy that's reported in the U.S. according to U.S. tests, and those reported in Japan or Europe.

And this, I think, comes back, and it

comes back to it seems that the purpose of this, reducing petroleum consumption or dependency is to insure low prices. And the NAS report noted this inconsistency here. And it's that if you maintain prices low, then consumers will drive more. And so things like this starts with arguments.

This is just some data showing the costs to drive versus the actual total miles traveled.

There is always, and always has been, I've heard it ever since I've been associated with the industry, and probably for years before that, that industry has technology; they have a 150 mile carburetor in warehouses in Detroit and Botswana.

But in fact, product development, the cycles are long. It takes a significant amount of time, particularly on advanced technology. Because not only do you have to test that, this is technology that goes on vehicles that will last for 10, 15 years, hundreds of thousands of miles, and people depend on these cars.

So it's not as simple as just throwing any technology that we find onto the vehicles. They have to be tested, and people depend on that.

These are some of the technologies, we'll forego that.

Again, this is a UCS fuel savings. And, again, there's some assumptions on lean burn technology. And, again, NAS pointed this out, there's a 20 to 40 percent improvement that can be had for lean burn technologies, gasoline and diesel. But because of LEV II, but then LEV II, of course, was carried over to Tier 2, so there's some concern there, as well, in some of the industry group.

Again, SUVs. There's just a fundamental disconnect if you believe that a Geo Metro should physically achieve the same fuel economy as a Ford Excursion. Following that logic you would say that an 18 wheeler tractor/trailer should also achieve the same fuel economy, or that a train should achieve the same fuel economy. It defies logic.

These are some of the hybrid vehicles. As I said, there's a lot of technology coming. It's here today. There's hybrid vehicles that achieve significant improvements in fuel economy.

There are fuel cell vehicles. And I think every major manufacturer is devoting enormous resources to all these technologies.

Just for conclusions, manufacturers are

increasing fuel economy, fuel efficiency at least. Consumers are the ones that actually determine the fleet fuel economy.

Advanced technology vehicles are the best way to meet this, meet the consumer demands. And with that, some recommendations.

On the regulatory, there has been some discussion about diesel technology, and it seems as though that regulation should, and I think Roland and I would agree on this, that there should be a harmonization between fuel efficiency, emissions, safety, because all these work together. And so there should be some understanding there.

The second is there needs to be an assessment of what are the current impacts of the current regulations, because we have a wealth of regulations on vehicles, from the emissions side, and a lot of these regulations, the electric vehicle mandate. Presumably will be met by smaller vehicles.

All of these will impact fuel economy, and yet there hasn't been any real devoted study to what impact these regulations will have on fuel economy or fuel consumption.

On incentives. Again, getting advanced technology out there is important. And incentives act in two mechanisms. First, there's obviously a benefit to the consumer because the consumer gets the incentive.

But second, and probably more importantly, and it shows that the state or the government's commitment to that technology, as well as showing, is raising the awareness. And particularly with fuel efficiencies. Consumers don't put it at the very top of their list unless gasoline is $2 a gallon. And as soon as it's $2 a gallon, everybody in the government works to try to lower the price. So it's kind of self defeating.

About leadership, every state can exercise, and again I think this is similar to what some of the earlier speakers have said, the state can exercise leadership.

The electric vehicle mandate is a good example of that. There is a requirement that manufacturers produce and presumably consumers buy electric vehicles. And yet the state hasn't made any commitment, themselves. Or even establish a goal to do so.

The second is, and I think it was raised earlier, is the purchase of alternative fuel vehicles or fuel efficient vehicles from the state.

So those are the items that I had, and that's all I have.

(Applause.)

MR. FONG: So we'll take just a few questions to those who have to ask those questions right now. Otherwise, I'll call it a morning and ask everybody to try to come back to the afternoon session starting at 1:30.

No questions? Good. Thank you.

(Applause.)

(Whereupon, at 12:40 p.m. the workshop was adjourned, to reconvene at 1:20 p.m., this same day.)

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AFTERNOON SESSION

1:20 p.m.

MR. JACKSON: The focus of this panel is to look at the role of advanced technologies and how they can play in the reduction of petroleum consumption in the State of California.

We've asked the panelists to give us their perspective on advanced vehicle technologies that they're most familiar with.

And the format here is to have each presenter, panel member, give us their remarks. This is a reminder to the panel, no more than ten minutes each, please.

We're going to use this panel here to talk from and the slides will be switched by our friends here at the Commission. I'm hoping to have about 30 minutes at the end of the panel when we can do questions and answers, so a Q&A session. We're hoping that you in the audience will be actively involved in this.

To help focus this panel, the panelists' remarks, we've put together a list of questions. I'm not going to read them all, but just to give you a flavor, some of the questions we asked the panel member are:

What technologies are likely to be introduced as advanced technology or likely to be introduced into vehicles in the next 10 to 20 years.

How will the technology evolve, given what the marketplace is, given what the emission regulations are, given whether it should be fuel economy driven or not.

And how will electric systems be integrated into some of these advanced vehicles. Are we just talking about accessories coming off the engines in terms of removing belt drive systems. Or are we really talking about getting electric drive technologies in the marketplace.

And along those lines, how will hybrids play a role in advanced technology.

And what kind of fuels are you going to need for these advanced vehicles. Is it going to be ultra low sulfur diesel, lower aromatics; are they going to be a naphtha, going to be GTL, gas-to-liquids, gasoline and diesels. What are they. What's open.

And what role will the alternative fuels like alcohol and biodiesel, hydrogen, natural gas, propane, what role will they play in the marketplace in the future.

And then the last question that I posed was if you were the person that was responsible for making investment decisions in your company, and you had to increase fuel economy by a factor of two in the next ten years, what would you invest in.

So, given that introduction, I'd like to introduce our first speaker, who is K.G. Duleep of EEA. K.G., you're on.

MR. DULEEP: Thank you. I'm back again. This just extends the last talk I gave on to some of the hybrid vehicle issues that we looked at for the National Academy.

Can I have the first slide, please. I'm sorry, the thing's not very visible. It's perhaps a little better at the screen, but there seem to be two bright patches of light on it, I'm not quite sure.

Yes, better, but not much better.

(Laughter.)

MR. DULEEP: The screen seems to be a little bit better here, but for those of you who are closer to the tv, but I can read off the stuff for you.

I think about hybrids is that there's no real definition of what a hybrid is. It can be a lot of different things. And we've tried to impose some order on this market here. And we've tried to classify them into four basic types.

One I will call is a starter alternator system. And the second I'm calling a motor assist system. The third I call a fully integrated system. And then the fourth I call a four-wheel drive system. That's what's in the middle of that page there.

And then, of course, you can combine these types of systems with different types of engines, perhaps a direct ignition gasoline engine, or a diesel.

Clearly there's a lot of issues about pricing of the different systems and what the value to the consumer is. And you can also think of the fuel cell as being a hybrid vehicle in the sense that the fuel cell providing the electrical energy and replacing the engine completely.

The next slide, please. This is possibly slightly more clearer. One of the things that happens is that you can think of current vehicles being at one end of the continuum of hybrids and the battery electric vehicle being at the other end of the continuum of vehicles.

And in between this, you know, you can change the motor size and the battery size to get what you want.

But what I have on the x axis is the motor size and kilowatts per ton of vehicle weight. And the first black bar is in the four to five kilowatts per ton of vehicle weight range. And that's what I call a starter alternator type system.

And the upward curve is the engine size. So the starter alternator system you really can't do anything to engine size because you need the engine to power you for the continuous power demand, and the starter alternator is just not enough to give you very much, except launch assist.

The next type of system which is around 10 kilowatts per ton of vehicle weight is the motor assist system. And then at maybe 18 to 20 kilowatts you get the type of system, the fully integrated system with the Prius, Tino type.

Then if we keep pushing it we get to 130 kilowatts per system, you can start talking about things like good connected hybrid or things that can be used as an EV at least, with some reduced performance.

So, that's kind of how you might want to think about hybrids. And depending on which bar you're on, the costs and benefits are quite different.

Next slide, please. The first kind is the starter alternator system, and that's really, I think, becoming fairly popular now. And what it is is essentially having a electric motor that's shaped like a pancake that goes between the engine and transmission.

Typically for say in cars that's one and a half tons or two tons, you're looking at something 6, 8, 9 kilowatts of power. And this type of system is also associated with 42 volt systems. And 42 volt systems make this fairly robust and easy to do in the sense of being able to handle the currents.

If many of you are wondering why people think 42 volts, it's because the international standards for being electrocuted if you grab the battery is 50 volts. If you keep it below that there's no danger of being electrocuted.

Which saves a lot of money; you don't have to isolate the battery, and you don't have to be careful about lead currents and things like that. So you can see why 42 volts is picked. It's sort of the highest practical level beyond which these other issues start to add costs.

Going on to the next one. The motor assist system is pretty much the Honda IMA type system. And it lies between the starter alternator system and the Prius type system. So you have some potential to reduce the engine size. You have some potential to do launch assist. You got more regenerative braking and so on. But you also have higher costs.

Next slide, please. The fully integrated system, of course, is the Prius type system that many of you are probably familiar with. This system is really based upon the idea that the engine can provide all your continuous power needs, and the electrical system can provide all your peak power needs.

So the engine plus electricals give you peak power and the engine gives you the maximum continuous power type system.

And if you do some analysis you can see

that that's kind of the best thing for fuel economy. But you do pay a price for it, because the components of the electrical components become quite large to give you that peak power.

And literally both Nissan and Toyota have this type of system. And it does have low speed electric vehicle capability.

Next slide, please. The last type of system is the four wheel drive system. And here, you know, one of the very interesting things is you can drive one axle, maybe the rear axle, with an electric motor, and the front axle can be engine plus maybe a starter alternator. And that's similar to the GM Paradigm system.

And what's nice about it is you get to throw away the center differential, the two axle shafts, and you get four wheel drive. And people like four wheel drive. They're willing to pay large sums of money for four wheel drive even if they use them twice a year.

And this type of system actually has some very nice advantages because you can turn the electric motor on at times when you need it, so it's often called an on-demand four wheel drive type system.

And it can be a very attractive system in providing you with sort of the bad weather benefits of four wheel drive, but perhaps not rough pavement capability. So if you're going to climb mountains or something in a four wheel drive, this type of system probably wouldn't be a good idea.

But if you're just using it for snowy conditions or slippery conditions, the on-demand four wheel drive actually has some very attractive features to it. Plus when you use it on a four wheel drive you're obviously it on a low fuel economy vehicle, so you can see that it has many synergistic benefits. And obviously, depending on the voltage you pick, you can sort of pick your power.

Next slide, please. We did an estimate of the fuel economy benefits and where this comes from. What that chart shows that you can't read is all the different sources of where you get the benefits from.

A large percent of the benefits for most of these systems comes from the fact that you can stop the engine at idle and during braking. In other words, you can always turn the engine on immediately if you have a large enough starter motor, which you do.

And some other parts of the benefits from the higher power systems comes from regenerative braking where you pick up some power in your braking.

You pick up some benefit from the fact that it can use the motor during the time you're accelerating from stop. And then under systems with the higher voltage you pick up some from engine downsizing and you pick up from the transmission.

And in the four wheel drive system, because you've thrown away the center differential and the axle shafts and so on, you pick up some from the drive train friction, too.

So if you look at the benefits, and what that particular chart shows is that that's the bottomline in sort of bold letters is that the starter alternator system on the city driving cycle gets you about a 20 percent benefit in fuel economy. Only on the city.

On the highway it gets you practically nothing. It's not even on, really.

The motor assist system does a little

bit better, maybe about 31 percent benefit on the city driving cycle. And a little bit of benefit on the highway because you've downsized the engine.

And when you get to the integrated system like the Prius, you get maybe 46 to 50 percent benefit in the city driving cycle, and maybe 10 or 12 percent on the highway cycle.

And four wheel drive system gets, even though it's a 42 volt system, gets a benefit that's roughly comparable to that of a motor assist type system.

So you can see that there are some good benefits to be had, and of course, the big issue is how much do these things cost. Next.

If you look at what the costs are, literally, you know, most of the cost issues center around first, how much does your motor and battery cost, and the controllers and so on. And second, how much do you save from eliminating things, either by downsizing the engine or the transmission or the center differential and things like that, as I mentioned.

And of course, when you start talking about motors and batteries, there are different kinds of motors. The Japanese like to use permanent magnet motors which are more expensive, a little more efficient, especially at low speeds.

But because Japan has very low speed driving cycles you can see why that would be a choice for the Japanese manufacturers.

But then using a permanent magnet means you have to stay below the Curie point of the magnet, which is the temperature above which they lose all their magnetism. And so you have to cool these things, and you know, the engine gets to be a pretty hot place. So permanent magnet motors have to use high temperature Curie magnets, and high Curie temperature magnets and cooling systems and so on, which you can avoid by using a somewhat less efficient induction motor.

And similarly on the battery side you can use a Ni-MH which is what the Toyota uses. Or you can use, there are some recent strides that have been made in lead acid batteries which sound like you can use it for a 42 volt system.

Next slide, please. We did some detailed cost estimates both for the Department of Energy and as part of the NAS study. And we found that a 42 volt system, if you're looking at it say maybe in two or three years, the cost, and again I emphasize the word cost not retail price, at low volumes like if you're buying 20,000 a year or something, the cost of the system would be about $1000 per car for a mid sized car. A little bit cheaper for a smaller car; little bit more for a bigger car or an SUV.

Which means the retail price would be something on the order of $1600 or $1700. So that's all the mark-ups that come from the supplier to the car.

At high volumes we can expect that to drop to maybe $650 or $700, which means you can get to a retail price that go to about $1000 for the 42 volt system. And that's considered sort of a holy grail for the suppliers. And that's with the lead acid battery.

If you go to a Ni-MH battery, the costs will go up a fair amount. But the good thing is, of course, that you never have to replace a Ni-MH battery potentially over the lifetime of the vehicle. Whereas the lead acid battery, the life is only in the range of four to five years. And even that might be optimistic. But some of the new batteries are doing that.

Next slide, please. When you get to motor assist systems we also costed these with some assistance from Honda. And we think that the costs of these, costs again not retail prices, about $1650 for a small car, much like the Honda Insight, which is what we used as a model to cost it.

But the retail price, of course, would be in the neighborhood of $2500. And this is just for the hybrid part of the system, not the rest of the car.

Next slide, please. Well, we did a cost of the Prius, and I know you guys have probably all hear the rumors about how Toyota is losing their shirt on selling these Priuses for $4000 apiece more than a typical car.

But after having talked with Toyota and gotten some data from suppliers I'm fairly sure that they aren't losing money on a variable cost basis.

Current costs at low volume productions, which is they make about 2000 a month of those, we estimate runs about $4200 in variable costs. Since they're selling it for that much it means they aren't recovering anything of their investments in machining, tooling and engineering.

But the other issue is if you look at all the kinds of advances that are being made, we expect that costs in the future could go down to about $2400, which is like a retail price of about $4000.

So in effect they're pricing it, it appears, to reflect their long-term costs and where they expect it to go. And we did a very careful costing, and what that particular chart there is sort of on a component-by-component basis, a motor, generator, battery and so on.

Next slide, please. We also costed out the new GM Paradigm type system. And this kind of system is pretty much like the 42 volt system except now you need two motors, one for the front and one for the back axle.

And we found that at high volume, and the fact you save a lot of money by eliminating the transfer case, the total cost is down to about $1500 for this type of system. Which means like a retail price effect of about $2400.

Interestingly enough that's how much the four wheel drive costs you. So if you wanted to buy a four wheel drive version of a two wheel drive vehicle that's how much extra they charge you. So this system's very competitive in the four wheel drive world.

Next slide, please. On the related issues side what do we find in terms of how attractive they are to the consumer. It turns out that, you know, a saving of about 10 percent, a fuel consumption savings of 10 percent has a value to the consumer of about only $350 at current fuel prices.

So you can see that none of these systems based on fuel savings are that attractive to the consumer. They're going to be attractive to some consumers, but on average it's not very attractive to the consumers.

So why are people doing it? First, I think it's because these systems offer a lot of other hedonic attributes that could be quite valuable to the consumer.

For example, the 42 volt system, once you have 42 volts in your car you can do all kinds of nifty stuff. You can do instant clearing of the windshield; you can do side window defrost; you can do systems like instant winter heat so you don't have to wait for your engine to warm up, et cetera.

So, at this point so you find that the hedonic values of many of these attributes provided are actually quite high. The cost, for example, of heated leather seats or something is about $400. So clearly people are willing, or some fraction of people are willing to pay very high prices for these hedonic benefits.

And so one way to achieve this 42 volt system and achieve it and make them quite viable in the marketplace is to provide many of these other very attractive features to the consumer.

So if we judge it simply on a fuel savings basis alone, 42 volts isn't likely to be a great winner. But if you look at it on a holistic point of view, you can see that the features provided by 42 volts are going to be very attractive.

And, in fact, I think the first applications that you will see are going to be in larger vehicles and in luxury vehicles. Mercedes, I understand, is going to 42 volts pretty much across the board. And that's understandable. They have a lot of accessory load, et cetera, and people like those features.

The second issue is that, you know, unlike many of those alternative fuel vehicles, hybrid vehicles provide fuel economy primarily in stop-and-go traffic. And so these are not vehicles where you save a lot of gas for the high mileage driver on the expressway.

So people driving lots of miles on the expressway will see virtually no benefit from buying hybrids, so it's targeted towards a completely different customer.

Third, I think you have to understand that hybrid vehicles are never going to be exactly like conventional vehicle, especially as you get to the bigger hybrids. If you do a long hill climbing out in the Rockies you will feel the difference. The capabilities can never be identical simply because it's going to run out of battery at some point, and so on, put large batteries in.

For, and this is, I think, a point that Dr. Frank may disagree with me, is that in our costing we find that grid connected hybrids have to have a large, significantly larger battery than something like a Toyota Prius does. And batteries are expensive. And so the cost of these systems are, with any reasonable range as a pure electric vehicle, the size of the motor and the cost of the battery always make good connected a difficult sell. You're almost getting to the point where it's close to being an electric vehicle. That's, as we know, is a difficult sell.

And lastly, there are some driving constraints in terms of trailer towing, et cetera, that makes hybrids not such a good thing.

Next slide, please. So clearly if you started looking at this issue of how to sell hybrids, we think that the simple 42 volt system does offer a lot of potential, not purely as a fuel economy device, but as a device that offers multiple benefits.

I think the four wheel drive system also could potentially be very popular; the on-demand four wheel drive system would satisfy, I think, a large majority of people who are buying four wheel drive systems that are designed for rough terrain, but use them for bad weather. And it gives you a lot of fuel economy.

And then lastly, I think that the higher voltage hybrids like those of the Insight and Prius are beautiful engineering pieces, remarkable in terms of what they've accomplished. But really quite a difficult sell in the marketplace at large volume, simply because the cost benefit equation is tough to bear out.

Nevertheless, the 42 volts and the four wheel drive we think are very attractive.

Last slide, please. I also wanted to say a brief word about fuel cell technology, which we did take a look at. And one of the things that we do find is that manufacturers, even to this day, even though there's a lot of stuff out in the press, they're just not happy enough yet with the performance of reformers that convert either methanol or gasoline to hydrogen.

Because the fuel cell, itself, runs on pure hydrogen. I'm sure you'll hear more about this from our other panelists. But at this stage the only system that we see as viable in the marketplace in the near term would be a hydrogen based system, because the reformers are just not there in a commercial sense. The stuff that you read in reformers, the fine print often tells you they're using a special gasoline or some kind of special hydrocarbon that's very clean, because the reformers do tend to get poisoned.

The second aspect of it that we looked at is this issue of how much do these things cost. And, boy, the numbers we come up with pretty high. The most optimistic study I've seen is one by Directed Technologies. They did that with Ford. And they assumed a lot of, the most favorable things that you could.

And they still came up with a detailed price differential in the $5000 range. Our own estimates are about double that. But, again, I have to stress that these are all quite speculative, simply because the technology is moving and it's hard to know where they're going.

But for 2004 and 2005 I suspect the only way the manufacturers are going to be putting these cars in the marketplace is by heavily subsidizing them, and offering them in very small numbers.

With that, I'll conclude my talk.

MR. JACKSON: Thank you, K.G.

(Applause.)

MR. JACKSON: Our next speaker is Ben Knight from Honda. Ben.

MR. KNIGHT: Good afternoon; I'm Ben Knight with Honda Research and Development. And

I'm glad to have made it up here for the meeting; I'm even happier that the rest of you made it up here to join me.

I've been invited to speak about natural gas. And because I just have ten minutes I'll concentrate there rather than talk about a very important efficiency technologies and hybrid vehicles that probably should be the backbone of any strategy group petroleum demand. If we have time afterwards I look forward to a discussion in that area.

At Honda, back one slide, at Honda we, some years ago, not so many years ago, took a fresh look at all of the practical alternative fuels. Natural gas came to the top of the list. If you looked across a broad spectrum of factors, it scored very high, very positive in many of them.

And some of the weak areas for the fuel we felt could be overcome with application of some of the newer technologies available, so some of the vehicle side issues such as increasing range significantly, or having good performance in the hands of the customer. And also reliability and durability which, in the early days of conversions, when the engine wasn't fully designed for the fuel, there were compromises.

Next slide. So, for natural gas this shows some of the key attributes of the fuel. It does have wide applicability. And I would stress that the light duty fleet, light duty does need a lot of attention. Heavy duty is getting attention now; a lot of progress is being made. And the light duty, in parallel with that, deserves, I think has earned a lot of attention.

The fuel costs for natural gas is less than gasoline. The economics are basically there on the fuel side. A lot of fleets will see a 25 percent operating efficiency benefit, you know, once they've experienced, once they've taken care of the infrastructure situation.

There's a wide range of infrastructure possibilities with natural gas, and this really can lead to some flexible or new architectures for deployments of fleets, or even at the consumer level, we see some possibilities.

It's also a low carbon content fuel which, in general, is a good future direction. And its costs are known and the performance now proven. We've got a number of vehicles with over

100,000 miles with exceptional emission performance.

Next slide. This slide shows the upstream energy chain. This is based on the Department of Energy's GREET 1.5 model. And shows natural gas, as well as gasoline, diesel fuels and electricity from different sources, gas, coal and petroleum.

This is the well-to-tank side of the equation. And the direct use of natural gas in the tank of a vehicle really has the least losses, so very desirable from that viewpoint. Even though the power plant is less efficient, significantly less efficient than an electric drive train, the upstream side is very nice.

Next slide. This is -- back, forward, there it is. I know that switch is very touchy. This is an evaluation of vehicle power trains. The first three columns relate to environmental factors, energy and emission factors. And the right three relate to marketability issues, including cost and infrastructure.

The gasoline vehicles, as well a diesel, are, you know, quite good; really excel on the marketability side. Whereas natural gas and the hydrogen fuel cell vehicle have rather outstanding performance on the social side.

Looking at natural gas specifically, two key issues end up being infrastructure, of course. And on the cost side, it relates to incremental costs for components, such as mainly the tank, fuel tank. Of course, increases in volume can somewhat impact this, the tank's inherently more expensive.

Next slide, please. This is our second generation natural gas vehicle. Or perhaps a third. We actually had a Civic and Accord in the market, a significant number of them a couple years prior to the launch of the first generation GX Civic.

What I'd like to point out is some of the achievements compared to past vehicles, or vehicles of the early '90s where range, we could crest 150 mile threshold frankly with a full tank. We're over 200 miles. That can be increased further.

Performance of these cars is like driving gasoline cars. This is very difficult with gaseous fueled internal combustion engines, how to equal the power since you're displacing so much air in the cylinder. We've basically overcome that with high compression and other engine parameters optimized for the fuel.

It carries a $4,500 price increment. And we are seeing very satisfied customers once they try it. They're adding to their fleets. They're planning to replace with like vehicles in the future. It's been a very good experience.

Next slide. A comparison with CO2 emissions, this is based on GREET's latest 1.6 model. I'm using actual production vehicles here. All four are sedans, compact class sedans, with Civic gasoline sedan on the left at 353 grams per mile. This is on the full cycle.

Diesel Jedda very high fuel economy vehicle at 306. And what you see here is that diesel and natural gas and hybridization have a significant impact over the baseline. Even when you factor in greenhouse gas, still you see this basic relationship, diesel and natural gas get closer.

Although I think there's additional opportunity here. Some of these numbers are old and don't reflect the newer technology vehicles, which really have no methane take-back effect on the vehicle side.

Next slide. Back one. On EPA's website, it's a little bit hidden, but they've got a 10 point scale, and this is on an absolute basis where it goes from 10 to 1, and it lists the ozone forming pounds per year at equal weight. Per year being 15,000 miles for the different vehicles, different standards.

This goes through LEV II, LEV I, Tier 2, Tier 1. So at the top, scoring a 10 is zero emission vehicles. Also the SULEV II vehicles which equals Tier 2, bin 2. These vehicles in a year's time are putting out, according to the standard, one pound of pollutant. And this includes the cold start operation.

Next slide. These are the actual certification results for the current Civic GX compared to the SULEV standard, just showing you that at 150,000 miles the NMOG performance is essentially as close to zero as you can get. It's an order of magnitude even below the standard. And again, this includes cold starts.

And also the off-cycle performance which includes transients and high speed. Natural gas is just an outstanding fuel the moment you start the car up from even wide open throttle accelerations, incredibly stable and low emissions when you design it with modern fuel control, feedback control and an injector system.

Next slide. By the way, back one slide, the toxic formaldehyde and the other toxic compounds are not detectible with the car.

Next slide. This is a page from a green guide, ACEEE's green guide, which is also on the web. And although I took this from Friday web posting, it's still not up to date, but it makes the point.

This is a very interesting analysis they do because they take both emission standards of vehicles, emission performance and energy performance and they weight that about 50/50. They even put some weighting factors on the emissions side, the air quality side, they weigh it according to health effects.

So both factors are considered in kind of a 50/50 ratio. And what you see in the result is that the natural gas vehicle matches or frankly exceeds gasoline hybrid by this scoring approach. And also electric vehicle, pure electric vehicle. And these are both extremely efficient cars, well designed cars that, in this case, it's off the national grid.

And it even matches the inside of two passenger world's top fuel economy car. So I think this is important.

Next slide, please. So, a key issue is, infrastructure aside, or the chicken-or-egg problem, and earlier speakers said that you really have to find ways, new ways, I think, to move both of these forward together.

Next slide. The vehicles now -- back three slides -- back one slide, yeah -- the vehicles are now from heavy duty to light duty are being introduced; very well designed and durable vehicles like the GX.

Next slide, please. And there's also additional possibilities in addition to needing a network of public fast fill to support the range of these vehicles, there's dedicated infrastructure possibilities. We're now seeing fleets that will have scaled down, dedicated installations, slow fill or fast fill.

And even in the future can see home fill with this fuel, just like the electric car. This can be a convenience feature that opens it further to the personal use market of AFEs, and that would be quite a breakthrough.

Next slide. Some of the technology relationships we see is clean gasoline and pure electric have really combined to enable gasoline/ electric hybrids.

And natural gas benefits, I think, from the battery electric. Takes some of the best characteristics of that being so clean, as well as having potential home refueling convenience, as well as internal combustion being familiar or the costs known and recognized. And this also may help us some day toward revolution in hydrogen fuel cell vehicles.

Next slide. Again, the backbone is the public fast fill infrastructure that can support all of this. And sometimes an installation can be supported by a number of small fleet, or even consumer vehicles in a given region. So there's some new approaches we can take. As well as home refueling, a $1000 home refueling appliances that can materialize in the next few years.

Next slide. A look at potential fuel savings, comparing NGV, the Civic, to a gasoline model. If the fuel price, I'm using $1.10 per gallon equivalent for natural gas, $1.60 for gasoline, about a 50 cent differential.

In that case in five years, about $1000 is saved. It's a little bit like the hybrid. That is not enough from a consumer's viewpoint to warrant the purchase relative to a baseline gasoline car. So that high initial cost seriously weighs on the consumer's mind.

Next. So to summarize, there is market growth potential here on the light duty side. It's really worth our attention. Air quality impacts rival zero emission vehicles when you include the upstream. CO2 benefits rival diesel and gasoline hybrids on a full fuel cycle. And it's an alternative to petroleum that has practical application today.

Next slide. I think two key factors that would help encourage growth of this market, and moving into additional markets would be incentives that are focused on the incremental price of these vehicles. That price very justified by the more expensive tank or fuel system.

Statewide incentives. We've never had that for natural gas. It would be a huge factor.

I think the kind of programs that CEC, the pilot program CEC and air quality management districts are developing are very valuable here.

And on the infrastructure side there's been recent work here that will also be extremely constructive. Upgrading existing stations; increasing the fuel performance. These newer vehicles have 3600 psi. They can get a lot more range if they're filled fully.

Common payment system. And new options including the home refueling opportunity. Move this into the consumer use. We're seeing some of that now, and it's been successful. And people tell us this is the kind of infrastructure support that would further encourage them.

And another great concept has been the public station network concept. New York's pretty advanced here, really networking the state, the corridors, key locations. So that for even some of the longer trips this vehicle can be practical.

Thank you.

(Applause.)

MR. JACKSON: Next speaker is Bob Graham from EPRI.

MR. GRAHAM: Good morning, everybody, or

good afternoon now. Thank you very much. I was a little concerned about getting here on Wednesday, Thursday and Friday and Saturday of last week, as I was flipping around airports and canceled airplanes. And I think this session, this conference is, of course, extremely timely. And I appreciate the opportunity to participate.

You heard from Dr. Frank earlier talk about plugging hybrid vehicles, and sometimes people scoff at Dr. Frank a little bit and laugh at him a little bit, but I tell you what, the man's got passion. And the passion for what he believes in is actually coming to be a truth.

And he mentioned briefly comparing the benefits and impacts of hybrid electric vehicle options. And this report is available on the EPRI web, www.epri.com. And it's available for one of the first times in history from EPRI for free. EPRI's not been known to provide free reports out.

But I think the reason it's free is because we want to share Dr. Frank's passion with everybody in the world to let them know that there is a practical opportunity for plugging hybrid electric vehicles. And I'm going to talk a little bit about that report today.

But I also more want to focus on market transformation and lead technology and how we reach and how we get things done as quickly as possible.

Because I think the slide Ben just put up there we could put back up, where he had a slide called technology relationships. I have to tell you I think that is the finest slide I've seen all day. Because I really do believe that that's the advantage and that's the future of the technology synergy between all these vehicles that we've seen, all these technologies that have been developed.

When you think about that synergy, and if we put the right emphasis behind that synergy, I think we have an opportunity to make something significant happen.

And I'm focused on significance. I'm not focused on incremental changes. I'm focused on trying to understand how we can lead technology forward. Let's talk about 30 to 60 percent improvements. Let's don't talk about 10, 12 percent improvements. Let's talk about how we can use public policy to drive the technology forward so that we see some leap improvements.

I agree entirely with what the Automotive Alliance speaker talked about earlier this morning, and the successes that the automobile companies have had in developing new technologies and new products. I think they've been marvelous. And I support what they've done.

Now the question is can we take what's been done by them, by Honda, by all the other manufacturers, and use that and develop vehicles that will make a significant impact.

So I'm kind of running this through waiting for -- it's called CEC. Appropriate. Guess I could have used CARB as well.

Briefly, this report was put together over 12 months of effort. It includes not only EPRI and the utility industry, it also included General Motors, it included the California Air Resources Board, South Coast Air Quality Management District, Argonne National Lab, NREL National Lab.

It included a number of players that were trying to take a very neutral look at hybrid vehicles, and trying to determine the value of hybrid vehicles to the marketplace.

And that's hybrid vehicles that have

zero all electric range up to 60 all electric range.

You can go forward, if you'd like. We're going to go through this fairly quickly so that we can meet the ten-minute objective that Mike has set for us.

The key to this report is its neutrality. We tried extremely hard to make sure that this was an unbiased, very documented report that has all the facts to bear witness to what we are saying.

If you were sitting in the rooms and listening to the representative from Southern California Edison argue his side of the coin, and then flip it to the other side of the table and have General Motors argue their side of the coin you would understand why we were able to come out with a report that we considered to be very unbiased and extremely well documented with lots of detail.

I urge all of you to look through this in some detail by going to the website. You can download it for free, and enjoy it as much as you'd like.

Please go forward. Okay, what we're

talking about is we need to develop a vehicle that's going to have maximum market pull. We can't afford to go out and build a niche car. We need to build a vehicle that somebody is going to want to buy at the higher price, which is what it's going to cost to buy a plug-in hybrid electric vehicle.

We know it's going to cost more, so what do we do to make that happen. So we asked the engineers and the people managing the study to make sure that if they were going to look at a plug-in hybrid electric vehicle, it had to meet all the existing performance requirements of an existing vehicle. And I can assure you that General Motors held our feet to the fire to insure that that did happen.

Please. Fuel economy. The numbers show that if you have an ATV zero, and ATV 20, an ATV 60 you can make a significant impact. What you have there is if the vehicle is gasoline only, electric only or with the utility factor where the combination of the two.

And, again, the details are in the report. But going through this very quickly, it shows you dramatically that we can make leap improvements.

Please. Same thing with the full fuel cycle energy use. You can see, as you drive down and get additional mileage of ATV 20s, ATV 60s, we have significant improvements. And as Ben said, you saw the same thing with an ATV zero. I'd love to have an ATV 60 with a natural gas engine in the vehicle. What a range, what a vehicle that would be. May have a couple of design problems of fitting the battery and the natural gas fuel tanks into the same vehicle, but what an ideal product you would have.

So maybe you end up with an ATV 20, which has a 20 mile range. There's millions of us that drive every single day less than 20 miles a day. So why not have an ATV 20 with 20 miles of all electric range with a natural gas fuel engine, next generation engine, on board to give it that additional range as required.

Next, please. Same thing with emissions. Again, the results of the study show that you can drive emissions down. These studies were done by Argonne and NREL. So this is the actual government studies using the government models. This isn't something that EPRI dreamed up; this is something that's used on a national basis to evaluate emissions.

We, too, did an analysis of electric power generation and the impact on pollution nationwide. And it's absolutely true, if you look on a national basis. I'm not sure you want an electric vehicle running in Alabama with coal fired plant, but you sure do when you have hydroelectric plants, or when you have nuclear plants, or when you have natural gas plants all over the country which are burning extremely clean.

So you need to look at all of that different data, and I think again, that's in the report. How we came up with all the analysis and where the emissions came from, and what the storage and what the model used.

Next, please. Same thing with CO2. I'm just driving home a point that you can build hybrid electric vehicles and plug in hybrid electric vehicles, make a significant difference.

I always talk about this as a family of vehicles. You will never hear me say hybrid electric vehicles in competition with plug-in hybrid electric vehicles. I do not believe that.

I believe there's a spot and a place for each of those vehicles in the marketplace. If each are working together we can create a market that's very large. And the consumer can make the decision as to which technology makes the most sense. So when I talk, I talk about hybrid electric vehicles.

We've recently formed an alliance to build off of our phase 2 project. And that alliance had 25 participants came to EPRI roughly three weeks ago.

Three automakers came to that meeting. The first thing they said is that the emphasis I had placed on plug-in hybrid electric vehicles was inappropriate. And they asked us, and we agreed, to change our thesis and our approach to look at hybrid electric vehicles.

So we have a hybrid electric vehicle alliance. Why? Because we are going to work together, all of us, the auto companies, EPRI, utilities to make sure that we can make a market.

Please. The cost is a major issue. There's no question that you have a cost differential between an HEV 20 and an HEV 60 and a conventional vehicle.

We've got the battery; we've got charging; we've got the systems integration; we have control systems. There's certainly additional costs that drive up that vehicle.

But the story I always tell when told that you can't sell a vehicle because of higher incremental costs, is come to my own household and go ask my wife why she bought a $35,000 Ford Explorer, and drives a half a mile to work. She bought it because for some reason she perceived that to be a better product, a better car, safer car.

So there is a reason, there is a way, even at a higher price, to create a market, provided we can create a product that has market pull and market demand. That gets back to what Mike was talking about, how do we get this into the marketplace.

Please. Same thing with fuel costs. Just basically these give you a dramatic example of we can reduce costs; we can reduce fuel consumption; and we can reduce our dependence on petroleum.

Continue, please. This just shows you that battery costs are an issue. It's definitely an issue that we're working on. We spent, Fritz Kalhammer and myself were sitting in DOE on Tuesday when all this came down. And talking about energy storage systems and how we can work with DOE, USABC and PNGB to figure out a way to drive the costs down for these batteries.

And I think we developed an approach. I heard somebody say earlier about 42 volt systems. It was recommended to us by DOE that we should consider, when we're looking at energy storage systems for plug-in hybrid electric vehicles that we should look at 42 volt systems that are being developed. It was an idea that came out of that meeting.

Unfortunately, that meeting kind of crashed on our heads a little bit fast. But it was certainly a worthwhile opportunity for us to sit down and talk about what the Department of Energy, of how they can assist us to make this product better and create a better opportunity.

Next, please. We did an extensive market study where we did focus groups in Los Angeles, focus groups in Orlando, Florida. Reams of telephone calls to look at customer preferences. And there's significant data that says there is an interest in plug-in hybrid electric vehicles, just like there's an interest in hybrid electric vehicles.

The question is how can you take that data that we have in stacks of Excel spreadsheets and analyze that data, and come out and determine what is the maximum market pull vehicle that we can create. Which vehicle, which platform is going to generate the maximum attention in the marketplace. So, not only does the customer want the vehicle, but the manufacturer will want to build it.

Continue, please. Again, this is just another example of the interviews that we did, and how there's certainly a difference in how many customers you would have if you had a hybrid electric vehicle that had a high price. Price does make a difference in the purchase equation, in the market volume. So it truly makes a difference. And, again, the details are here.

And I would offer to anybody, as we have to the auto manufacturers, and to anyone else that has an interest, if you have a desire to participate with our alliance, please come forth. If you have a desire to see our data, come forth, we will provide you that data.

Everything that's in this study is absolutely totally 100 percent public information. And we are very pleased to provide that to those who want to see it.

Next, please. So, again, the market shows, this basically shows you graphically that this product is price sensitive. If the price is too high you're not going to be able to market that vehicle. So, we understand those issues and are concerned about them.

Next, please. That's the same thing, so go on, please. Okay, so where do we go now with our phase two. We're going to spend $1.6 million over the next 18 months to go beyond the proven concept, which is what we think phase one was. It's definitely a proven concept that says this technology will work. We can make this happen.

But we have a lot of work to do before we reach the point where an auto manufacturer is going to spend millions of dollars to bring this to production.

So, at the end of the day we need a very strong business case that says to an auto manufacturer, this is worth doing because we're going to have to step up to the plate and ask them to spend the necessary dollars to accomplish this commercialization.

Everything we do is based upon commercialization. And what we have to do is basically four steps. We have to do confirmation of the proof of concept. We have to do the in-depth technical analysis of the systems and components. We really need to know what the real cost of the battery is going to be, what the cost of the system is going to be.

We need to determine what the market configuration will be that will create the maximum market pull. What's going to get this technology into the marketplace. One of the questions that Mike asked all of us is what do you need to do to get this product in the marketplace.

And what you need to do is you need to get a customer that demands it, that wants it; says, I need this. It attracts attention to the marketplace.

Third, we're looking at next generation systems. I, again, listened to Ben talking about the home fueling systems. We agree totally that there's an opportunity for a plug-in hybrid electric vehicles, natural gas vehicles, to plug into the home infrastructure for recharging, providing power back to the grid. For using in an emergency basis, turn on that very clean natural gas engine in providing power in an emergency, wherever it needs to be provided. We strongly support that, and have a task to take a look at that.

We believe also that the plug-in hybrid electric vehicle might be the perfect host for a fuel cell. Don't have the answer to the question, but you think about it for a minute. One of the things that we're asking in fuel cell vehicles is that they be instantaneous. That when I get in the car on a cold morning I want that fuel cell up and running so I can go get milk, I don't want to wait.

So, maybe, if you've got a 20 mile range or 30 mile range on an all electric configuration, maybe that's what gets you to the milk and back. So, therefore maybe the fuel cell doesn't need to be quite so large, or the control systems of the fuel cell may be less complex, therefore driving the cost down.

Therefore, a plug-in hybrid electric

vehicle successful in the marketplace may be the first and most logical path for the fuel cell to enter the marketplace in significant volume. We have a task to look at that. We're going to spend some significant dollars asking the questions I just asked to find out whether I'm right or wrong.

And finally, I mentioned earlier, our national hybrid vehicle alliance. That's so that we can spread the word, so that we can get more people engaged than just the number of people that are part of our team.

Next, please. So what do we need to do to make all this happen? How do we make it happen? How do we answer Mike's questions?

Well, we've got to build a ground swell of interest. And we do that across vehicle platforms. We have an automotive project; we have a step van project; we have a 40-foot bus project; a 35-foot bus project; and a shuttle bus project. All plug-in hybrid electric vehicles.

I want to know whether those vehicles will reduce operating costs, and operating costs, petroleum consumption reduction. It's a given to me on emissions. I want to know can we reduce costs. If I can reduce costs in fleets, or with the consumer, then I think people will buy this product. And we're going to make that happen.

We need public policy leadership. The whole discussion that you're having here about what do we need to do from a public policy perspective to make that happen. Well, I think the public policy perspective ought to be that we're looking for lead technology improvements.

And we're going to focus our issues, our thinking, our direction on insuring that we're not going to settle for incremental improvements, but we want 30 to 40 to 60 percent improvement.

Finally, we need alliances. I've talked about the alliances we created with the phase one, when you have an auto company. You have an emissions regulator like CARB. You have utilities. You have national labs. In this particular phase two case we have the Department of Transportation. We're creating alliances to make this happen, we're letting people play as they need to.

And finally, you need synergy between all these hybrids. You need synergy between all these vehicles, and I think there's some real possibilities for that.

Next, please. So I talked about market transformation until you're tired of hearing me talk about it, but I believe in creating product demand, market pull configurations. I think there needs to be a new attitude. I think we need to do leap improvements.

Public policy I just mentioned. I believe very strongly in marketing muscle. I believe that you can get my wife to buy a $35,000 Ford Explorer if you market it right. She did. And I think the same marketing muscle can cause plug-in hybrid electric vehicles to do the same thing.

We need an automotive manufacturer. We absolutely cannot succeed without an automotive manufacturer. I spend half my waking time trying to persuade auto companies to be engaged. And the way I'm doing that is I'm creating peripheral projects or tasks so that an auto company can come in and be involved in our marketing study; or they can be involved in the fuel cell study; or they can be involved in the energy storage analysis. So they don't have to be part of the main program. They can be part of the program looking in from the outside.

Let's combine with a university that has an interest in a fuel cell with an auto company to get them engaged. So I'm reaching out and touching them, recognizing how difficult it is to do that.

Finally, we need very good sound engineering and accurate costs. And, again, I keep harping on it because Ben started it, talking about system and component synergy. I agree, absolutely, that we have some technology relationships that make sense.

And I think we're just about done. One more, please. I think we are done. If you ask me where I want the R&D spent, I'd like to see some drive electronics, continue to spend on drive electronics development. Hybrid system component synergy, and I've beaten that to death. Ultra capacitors and ultimately demonstrations.

And I'd be happy to answer any questions. As you can tell, it's not just Dr. Frank that's got a little passion for plug-in hybrid vehicles, I got a little passion, myself.

Thank you.

(Applause.)

MR. JACKSON: The next speaker is

Shannon Baxter from the California Air Resources Board. Shannon.

DR. BAXTER: All right, I'm going to be walking a fine line today. I was asked to talk about fuel cell vehicles, and a lot of the questions that we received were pertaining to when will you see fuel cell vehicles in commercialization.

And the Fuel Cell Partnership has a study coming out next month, and it's looking at different commercialization fuel scenarios for fuel cell vehicles. And I'm going to try to walk a fine line of talking about these questions but without going into the study. And to keep you in suspense a little while longer for that one.

The study was done by -- it was led by a team of experts -- it was conducted by a team of experts, led by Bob Knight of BKI down in Oakland. And it was commissioned by the partnership.

Next slide, please. The one before that, please. That one. Perfect.

Just to give you a basis of what I'm going to be talking about today is the platform of a light duty, like a passenger or an SUV vehicle; polymer electrolyte membrane. And I'm looking, I'm going to be talking about different fuels, because the commercialization of fuel cell vehicles is highly dependent on fuels and fueling infrastructure.

All three fuels have different financial costs and risks and societal benefits. A gaseous fuel like hydrogen, you're going to have a higher cost for your infrastructure. But your vehicle is simpler to construct. It's a simpler technology.

Whereas when you get into your liquid fuels you have a less expensive infrastructure. You have less chance of financial risk but your vehicle is much more complicated and more expensive.

Next slide, please. Market timing. One of the questions we were asked was what technologies will be available in the next ten years. And I can really only tell you where we are at this point.

Most OEMs have a handful of fuel cell vehicles. There's a number of them out in the West Sacramento facility. And there have been a number of predictions. You can see one from API and AMI. And then, of course, there have been the ones from the automotive manufacturers. And they've been revised more than once, probably.

But my sense is that we'll start to see commercialization, or at least a buildup of vehicles by the end of the decade. But this is dependent on many factors that I will talk to you about.

Next slide, please. Drivers. There are obvious drivers for fuel cell vehicles. Environmental benefits, and this includes air quality and water quality, and they vary per fuel.

For hydrogen I think that's the most clearly defined with regard to environmental benefit. Methanol, there's some questions concerning toxicity and effect on Btex plumes left from gasoline leaks.

And when you talk about a heavy hydrocarbon fuel you don't need oxygenates for a fuel cell vehicle. And sulfur is not tolerated by the fuel cell.

Energy security. I don't think we need to say anything more about that today.

And consumer demand. The vehicles are quiet and they may be able to provide features like preheating, precooling. You've heard about some of those things. But something that's kind of interesting is there's a group in Palo Alto that's an in-house consultant group for Daimler Chrysler. And they look at populations and try to predict where the market should go.

And they've noticed there's a growing population of pet owners. And so they're looking at how they can respond to this type of need. Fuel cell vehicle, if you took your dog or cat or whatever you've trusted to be in your car on a day trip. If you wanted to go in and have lunch somewhere, then you'd be able to run the vehicle and keep the animal cool.

Next slide, please. Of course, one of the most important drivers to the Air Resources Board is emissions benefits. I'm going to show you a couple of slides about some emissions, local smog precursors. And we're more interested in looking at local emissions from the fueling station to the tail pipe when we look at these smog precursors, because they're more detrimental, obviously, in the congested urban areas.

When we talk about greenhouse gases we need to look at life cycle because this is obviously a global issue.

Next slide, please. And I did have a

picture of a Honda fuel cell vehicle up there, but it -- the computer wouldn't take it for some odd reason.

(Laughter.)

DR. BAXTER: Here are some predicted numbers for the smog precursors, and I really don't want to get into the nitty-gritty of this. But what I'd like to show you is that the hydrogen fuel cell vehicle, which is the bottom bar, is obviously the lowest number.

You have above that the gasoline hybrid electric. Above that, the gasoline PZEV. And above that the gasoline model year 2002. So you can see the range there, and you can see that the hydrogen fuel cell vehicle is much cleaner.

Now, this is data from the GREET model constructed by Michael Wang and Argonne National Laboratory, Bob Knight and Stefan Nunasch worked with him because DOE agreed to do some scenarios for us.

The next slide is predicted level for -- predicted local air pollutants for methanol fuel cell vehicles. You can see that the methanol fuel cell vehicle, you have some additional smog precursors. You have a low temperature reformer that's operating, but the emissions are from refueling and evaporative. There's even a little bit for delivery truck to the fueling site.

Next slide, please. And you can see the bars getting progressively larger.

Next slide, please. Here what we have is the model year 2002, the gasoline PZEV, the gasoline hybrid. And then when you come down you've got a gasoline fuel cell and a low RVP hydrocarbon fuel cell.

And what we're talking about with the gasoline fuel cell is a gasoline that would be able to refuel both internal combustion engine vehicles and fuel cell vehicles. The low RVP is more of a naphtha cut, and so it's going to be a simpler structure. Negligible aromatics and sulfur.

I want you to note that these predictions are just that, predictions. There are other predictions out there. General Motors has some predictions that are a little bit different. They don't take into effect some of the transients of the gasoline reformer. So, just keep that in mind when you read numbers like this.

Next slide, please. And here we have --

the reason I put this slide up is because an issue that I feel very strongly about is looking at renewables. And when you're talking about the hydrogen future you need to always keep in mind the development of renewables.

You can see on the x axis is fuel economy; on the y axis is greenhouse gas emissions in grams per mile. The lines that you see that are sloping are different hydrogen production techniques. The box to the right, the smaller box, is a range of fuel economy for the fuel cell vehicle. And that's because this is predicted data. We don't have actual data at this point.

The dots to the left are predicted greenhouse gas emissions from lightweight gasoline vehicles, one being the ICE, one being the hybrid electric vehicle.

And if you follow these numbers into the box you can see that our nearest term option for producing hydrogen, an electrolyzer using a natural gas power mix, you've got higher overall life cycle greenhouse gas emissions than you do from the lightweight gasoline ICE.

And then if you look at the bottom at the red line, this is the electrolyzer using renewables. And so I think that in order to move into this hydrogen future, and to look at hydrogen fuel cell vehicles, we also need to look at overall data like this.

Next slide, please. Okay, predicted fuel economy. These numbers are predicted by a model that uses present day technology and a lightweight body. And you can see that the PNGV style ICEV about 45 miles per gallon; the hybrid higher, of course, at 60 miles per gallon.

And then the hydrogen is the highest, hydrogen fuel cell vehicle. But if you get down to the bottom and you look at that gasoline fuel cell vehicle you don't see the benefit with the fuel economy. Of course, this is predicted.

And so you say, well, what's the draw. You have some emissions benefits, but not a lot. You don't really have a lot of fuel economy benefits. But the draw is obviously the infrastructure.

There are two types of gasolines that I mentioned to you earlier, one that can only be used with fuel cell vehicles. But even with this you'd have a limited investment, and you'd have less chance for a stranded investment.

The second type of gasoline would be one that would be used in fuel cell vehicles and internal combustion engine vehicles. And there's talk that you wouldn't need a whole new infrastructure. And that may or may not be true at this point; it's a matter of opinion.

An article came out in "New Fuels and Vehicles Report" in July, and it talks about the absorption of sulfur into carbon steel and how it can release that sulfur into a cleaner fuel, so you'll have actually a higher sulfur content in your fuel delivered to your vehicle. So this infrastructure question is still very contentious.

Next slide, please. All right, the last driver that I'm going to mention. I sort of snuck this in because I feel like it's my duty, but as a partnership working group member, I try to keep this a little hush-hush. So I'm hoping Ben will maybe turn his head a little bit. Are the ZEV credits.

With regard to drivers, zero emission vehicle regulations, and you can see that at this point auto manufacturers are receiving 40 credits for every fuel cell vehicle they produce. It's pretty high. And then you can see by the year

2012 it decreases significantly.

Next slide, please. I think this is fine. You can go on to the next one, please. Challenges. So just to sort of recap, some of the competitive technologies that are challenges to the successful commercialization of fuel cell vehicles, hydrogen internal combustion engine vehicles that BMW has coming out. The gasoline hybrids, they look pretty good next to those gasoline fuel cell vehicles.

And even the competing technologies within the fuel cell vehicle market. Hydrogen storage, the different reformer technologies. Which one is going to come first. And it can make a big difference, especially once you've started investing in infrastructure.

Experience -- or costs, I'm sorry. Cost is one thing that, like I talked to you earlier, infrastructure is inversely proportional to vehicle most likely. And where that's going to balance out we can't say at this point.

Experience. We need experience with these vehicles and with the fueling. We need public acceptance. And we need not only public acceptance, but we need to create a market demand.

Safety, codes and standards, infrastructure.

Infrastructure, not just with regard to fuel, but with regard to maintenance, housing, emergency response, all that needs to be set up.

Next slide, please. So what's it going to take to commercialize the fuel cell vehicles. That's one of the questions we were asked. What will it take to make this technology successful.

Unprecedented cooperative effort. Reduction in costs. The Department of Energy says that they don't believe that these costs will come down with increased production alone. It's also going to take some technological breakthroughs. They're looking at compressors. They're still looking to reduce the costs of the amount of catalyst that's in the fuel cell, as well as other parts of the fuel cell.

Regulatory actions, incentives, not just ZEV regulations, but it's also incentives. It's the carrot and the stick. Alan can tell you all about that. Consumer demand and outside forces. Outside forces like we've experienced in the last week.

You could have a radical change in your climate. You could have an energy crisis or a disaster. And something like that is what it takes to change consumer behavior, an energy crisis. They don't change for no reason. There's got to be a huge factor. So, this is something that could come into play.

Next slide, please. In summary, it's not a clear path, but it's definitely a do-able path with cooperation from all parties. We have unpredictable market forces. We have technological challenges. We need these vehicles to be durable.

But the social benefits have not been fully qualified, but the data looks very promising. The financial risk. Like I said before, we can't tell you what the sum of those risks are financially, but also who's going to pay for it. Is it only the consumers, or is it the government, or is it society, as a whole?

I'm not a gambler, but I'm optimistic. But I realize that this is a tough row to hoe. But I think the saying goes that nothing that's worthwhile is ever easy, and I think that's definitely the case in fuel cell vehicle technology.

Thank you.

(Applause.)

MR. JACKSON: And our last speaker is Jason Mark. Jason is with the Union of Concerned Scientists. Jason, if you could sort of keep it to ten minutes, that would be wonderful.

MR. MARK: I will.

MR. FONG: Jason, we're going to have to load your material.

MR. MARK: Okay. I'll just fire away, if that's okay, while we're loading.

I was going to spend a few minutes to really take a step back and talk about this whole family of advanced technologies that you've heard already quite a bit about.

Going with letter A, thanks. And what's, I think, ultimately clear is that the opportunities for advanced vehicles and advanced technologies to deliver breakthrough environmental benefits are crystal clear.

What's, I think, unique about the technology is its ability to deliver simultaneously -- you can just jump right into the next slide, Dan, thanks -- deliver simultaneously on a range of environmental metrics, borrowing from one of the largest oil companies in the world. Certainly moving beyond petroleum is one opportunity advanced technologies have the potential to deliver. And I'm going to emphasize the word potential, and talk a bit about that in just a minute.

The potential for significant greenhouse gas savings; zero and near-zero emissions. These are, of course, all things that you heard more about with earlier speakers.

The other key item here is that while we spend most of our time talking about passenger vehicles as the number one priority, and it should be from a petroleum dependence perspective, clearly the opportunities for advanced technologies extend well beyond just light duty vehicle technology, and to heavy duty nonroad engines.

There are a range of transportation challenges that we're facing. If we can go to the next slide, I am going to focus a bit on the light duty sector just for a moment here. I won't talk through the gory details of this slide. It's a bit outdated. It's an analysis that I undertook a couple years ago to try to just put some of the options in perspective and try to get an idea of where are we headed and how do we get towards zero in terms of two key criteria.

Climate change on the y axis and air quality. And what I'm looking at here is both fuel cycle analysis and to the extent that we're looking at air quality emissions, I'm actually using a public health weighting for the different pollutants of concern.

And I normalized everything, so 1.0 for climate change and 1.0 for air quality is a LEV II 27.5 mile per gallon passenger vehicle. So that's sort of my starting point.

And as you look at the range of options it's a little bit like an ugly geometry class here, the squares are conventional technology, the triangles are hybrids, the diamonds are fuel cells and the circles are battery vehicle technologies. And then you see all the different fuels that I'm assuming along the right-hand side. With a great job of the color work there, my apologies.

The point being is that clearly the technologies offer an opportunity for getting towards zero. And it's particularly the advanced technologies and fuel cells and batteries, and to some extent, hybrids, as well, that really get us towards that end.

There are clearly some, I think, potential detours in the advanced technology arena, as well. One of them is all of the shapes that are supposed to be shaded in with black, those are the diesel options, suggest that the emissions implications of a diesel-based system even if it can achieve, I think, an amazing goal of getting to the LEV II emissions levels. That would still leave it far behind the competition in terms of delivering on the environmental priority, the air quality priority.

If we can just go to the next slide I'll summarize some of the challenges, I think, in advanced vehicles. One is that not all advanced vehicles are created equal when it comes to an environmental perspective. And yet environmental concerns have, in many respects, been the driving force behind these technologies.

I recognize there are clearly other forces at work here, in particular, electrification of vehicles to deal with auxiliaries and so on and so forth.

But given that environmental priorities are a driving force here, and one of the leading forces, I would argue that advanced vehicle development needs more attention to the environmental targets that we ought to be seeking.

For example, weak hybrids really offer modest fuel economy or greenhouse gas savings. There are a range of advanced technologies getting all sorts of press and I think policy-maker excitement coming from a number of automakers. Most particularly the Big Three that really deliver minuscule improvement.

If we're talking about taking a Dodge Durango from 15 to 18 miles per gallon the fuel savings may be significant, but you're starting with a vehicle that is at the very lowest end of fuel economy for the typical driver's needs.

If you're talking about boosting fuel economy by 10 or 15 or 20 percent using essentially a 42 volt starter generator system, I wouldn't suggest that qualifies as advanced technology.

Similarly, as we just heard, the gasoline fuel cell appears efficiency limited and begs the question of why bother, quite simply, with that particular pathway.

And there has been some discussion

already about diesel cycle engines struggling on the emissions front, the lean-burn strategy.

Just one point of clarification. From this morning there was a comment from the Alliance of Automobile Manufacturers that UCS' recent fuel economy study looked at lean burn gasoline technology. Actually, we looked at a stoichiometric direct injection strategy, not lean burn. And recognizing that lean burn does, in fact, have some emissions challenges.

And I think the diesel cycle certainly faces far more of those challenges than the gasoline lean-burn direct injection system.

And then next, alternative fuels are a necessary complement, so I recognize that we've, of course, split into individual panels here to talk about fuel economy, more traditional efficiency improvements, advanced technologies, fuels and then land use.

But clearly, I view alternative fuels and advanced technologies going hand in hand. Petroleum fuels can only take us so far. And I think my attempt at a quantitative slide before tries to make that case numerically. And that these inherently cleaner fuels are really where we need to go to unlock the full potential of advanced vehicles.

The next slide. So how do we address some of these challenges. Well, certainly, and this is one I think a number of folks, both in industry and the environmental community are fond of talking about, but we probably don't agree on exactly what it means, is setting performance targets.

They need to be comprehensive and integrated. We can't simply just look at a petroleum displacement strategy, or a greenhouse gas strategy. I think that is the major shortfall of the now infamous partnership for a new generation of vehicles, PNGV, which took a purely fuel economy focus to its strategy. And I think ignored, to its detriment, the air quality pieces. Ultimately PGNE may be headed for building a vehicle that is illegal for sale in California.

Regulated air pollutants, without a doubt, are a priority. But also nonregulated air pollutants. We need to, I think, look down the road if we're talking about technologies that are going to be mass market down the road, we need to be thinking about the types of air quality and environmental challenges facing us, toxics, ultrafine particles.

The range of issues that aren't currently built into our regulatory infrastructure, but likely will be down the road. Water, solid waste issues without a doubt, as some of California's recent experience, I think, has highlighted.

And then second in terms of performance targets, real world. The real world is far more important than, I think, the laboratory certification. World, when it comes to real world public health and environmental benefits.

Huge gaps, I think, remain in many parts of the transportation sector, especially in the heavy duty market, between end use emissions and certification. That is a gap that will have to be closed, I think, through regulation, over time.

And will have important implications for advanced technologies, if we can assume, and I think in some cases we can and in some cases we can't, advanced technologies deliver an advantage in the real world, in real world driving conditions.

Then I think one of the keys to pushing

advanced technologies is going to be making sure we're holding the conventional technologies accountable for what they're actually delivering in the real world. And also, over their entire lifetime.

We continue to regulate heavy duty engines for less than half of their real world lifetime. Probably not an issue today for existing control systems, but as we start to put sophisticated emissions control systems on, for example, heavy duty diesel engine technologies, durability, I think, becomes a significant concern.

These relate to advanced technologies, again, I think, because where we head with these in terms of the policy, in the policy venue, will really have an impact on to what extent advanced technologies have a chance to shine as inherently and intrinsically cleaner vehicles.

And then my last slide really, I think, underscores some comments you heard earlier this day from Roland Hwang, my colleague at NRDC. The need to integrate strategies, both across much of pollutants, but also technology mix.

I think one of the -- I spent a lot of

time in Washington, or until recently in Washington D.C., talking with policy makers. And I think they often argue that advanced technologies are right around the corner, so why bother doing anything on CAFE, or why bother doing anything to boost the fuel economy of today's technologies.

And I think perhaps more correctly the conventional technologies offer a huge opportunity in the short term, but those advanced technologies are what will take us to the next step.

I'd already mentioned the fuels as a priority as enabling strategies for delivering on the full promise of advanced vehicles. And then the policy mix. We have R&D, and perhaps I should add another D there for demonstration programs like PNGV, like the California fuel cell partnership. I don't put them in the same category.

Politically, incentives programs that are emerging both here in the state and also federally, they're going to be vital.

But ultimately, I think, California, the reason why we have things like the California Fuel Cell Partnership, the reason why we have hybrid vehicle sales higher in California than anywhere else in the nation, the reason why we have battery vehicles on the road at all in California is because of regulation.

I don't think we can miss that opportunity to highlight the need for pulling these technologies or pushing, as the case might be, these technologies into the market through strong regulations complemented by RD&D and incentives.

Thanks.

MR. JACKSON: Thank you very much, Jason.

(Applause.)

MR. JACKSON: Okay, the next phase of this panel is to get some questions from the audience. And I've also asked Fritz Kalhammer to assist me in formulating questions to the panel, too.

And lastly, i think the panel should be able to ask questions of any of the panelists. So, with that, I'm hoping that we can run this for another 20 minutes or so, anyway, if that's acceptable to the organizers here.

So, we'll try the audience first.

Please, step up to the mike and identify yourself.

DR. TRINDADE: Thank you, Mike. My name is Sergio Trindade; I'm a Consultant based in New York, interested in ethanol.

The question goes to Shannon Baxter. I understand fuel cells are perhaps ten years in the future as part of the mainstream automotive power train. I understand you expressed interest and concern about renewable fuels as part of this new technology.

And the question is of the fuels that I saw experimented with, like methanol and gasoline and natural gas, I mean hydrogen, I'm sorry, generated from fossil fuel driven electricity generation, don't see any renewability there.

The question is, therefore, since California, to some extent, with or without a waiver will consume a certain amount of ethanol in the fuel blend for octane values and other values, and since the nation-state of California trades with the rest of the country, and also with the rest of the world, there are sources of ethanol outside the United States which are very renewable in terms of greenhouse gas credits.

And if one day the United States wakes

up to the Kyoto Protocol and adheres to it, it might find a value there.

So, boiling all of this down to a question, has ethanol been tested in this process of developing fuel cells in California. And if not, is there any plans to test it? Thank you.

DR. BAXTER: Thank you. As far as is ethanol being tested, I might let Ben speak to that question, as to if it's actually been tested.

But as far as ethanol for a long-term fuel for fuel cell vehicles, Bob Reynolds from -- right, he actually worked on our team of experts, and there was a conclusion that there can be a dual strategy for ethanol. But ethanol, as a single fuel for fuel cell vehicles, there's a supply issue with the long-term strategy.

It would probably suffice for the first ten years, but then after that we'd be in a supply demand.

DR. TRINDADE: From domestic sources?

DR. BAXTER: I believe you're probably right.

Ben, do you want to speak to if ethanol is actually being tested in fuel cell vehicles?

MR. KNIGHT: At Honda our work has been

focused on direct use of hydrogen for a variety of reasons, and also we're developing reformers and done work with methanol; it reforms at low temperature.

Some work with gasoline as a broad fuel that's available, rather than -- so we have not done testing with ethanol. We're using it, you know, in Brazil it's part of the mix in the gasoline. Our vehicles are compatible there. That's one way to use that fuel if it has CO2 benefits, for example.

And I think the issue with ethanol is similar to the issue with gasoline, that high temperature reformers are needed. And that technology has a way to go before it's practical.

MR. JACKSON: Next question?

MS. McDOUGAL: My question is for Jason Mark.

MR. JACKSON: Please identify yourself.

MS. McDOUGAL: I'm Ruth McDougal, and I've worked in electric transportation at SMUD for ten years.

And I'm very familiar with the issues that you've all raised about marketability and cost of alternative vehicles and also energy efficient vehicles, and however things have changed dramatically recently. We're now spending $40 billion plus, you know, to clean up the mess in New York, and to gear up for a war, which some perceive as maybe another oil war.

And I think that there's an opportunity to present an alternative to the American people about these alternatives to sending their sons to war, for instance, fuel efficiency standards, incentives for alternative vehicles, regulations, you know, for alternative vehicles, and efficiency.

And with the current situation, you know, we can throw out our past assumptions about marketability and the cost effectiveness, because we are spending money for the alternative.

And I believe we need to stop preaching to the choir, and I think that Union of Concerned Scientists is sort of an unbiased voice that can maybe present this to the media.

We also need just, you know, spokespeople who can bring media attention such as maybe S. David Freeman or Amory Lovins types that perhaps will get some, like I say, media attention.

But we have an unusual opportunity now. We need to just shout this message to the mountain tops that there is an alternative. And I think that people are motivated right now to rally around a new flag of efficiency and alternatives, and pay the price, you know, for those alternatives.

So, I hope that you get that word out. Do you have any plans to bring this to national media attention?

MR. MARK: Well, I appreciate the comments. As you may know, the Union of Concerned Scientists, and really most of the nation's national environmental organizations have been working fairly aggressively on national energy policies, since this administration came to the fore in January.

And it's difficult to say how, yet, I think, how the recent events are going to impact the discussion in Washington, D.C. It's quite clear that some in Congress are already using the opportunity to call for, for example, drilling in the Arctic. That is something that's come from both Alaska senators just in the last week.

So, the debate is clearly shifting. But

pre September 11th, I think, the debate continues to be trying to get the American public concerned about this notion of alternatives. That efficiency does deliver a superior alternative than drilling in pristine wilderness arenas.

But it's an uphill battle.

MS. McDOUGAL: Thank you.

CHAIRMAN LLOYD: Alan Lloyd, Air Resources Board. I don't think we should let Fritz get away. With his caliber, Dr. Kalhammer, I'd like to get some of his views on what he heard on this technology and --

MR. JACKSON: We were holding the best for last, Alan.

CHAIRMAN LLOYD: Okay, well, --

MR. JACKSON: But thanks for bringing that --

CHAIRMAN LLOYD: Okay.

(Applause.)

MR. JACKSON: By the comment I meant I was going to have Fritz summarize his thoughts on this panel after all the questions were done.

MR. WUEBBEN: Yeah, I'd like to ask Ben what type of timeframe -- Paul Wuebben with the South Coast Air Quality Management District.

Ben, do you think that it would be feasible within the next seven to ten years to establish your entire product line as a hybrid product line if you were under tremendous national urgency to do so?

MR. KNIGHT: -- stating the question is a very simple one, but I think it's complex. So, no, I don't think that timeframe is do-able. I think more lead time is needed. And that's assuming this is the direction or a key direction that we should all or could all focus on.

I think you'd have to look at a decade and a half kind of timeframe. I mean, just -- I'm expecting something like 15 percent hybrid penetration into the next decade, rather than 100 percent shorter term.

MR. WUEBBEN: I mean if the state considers itself under tremendous duress in terms of availability of supply, criteria emission issues, global greenhouse gas risks, et cetera. And if there is, in effect, a coalition and a cohesion of interest and commitment.

Do you think that there could be a maximum effort in place that would create within five, seven, ten years, a extremely high penetration scenario? Is such a scenario imaginable, I guess is what I'm trying to at least get on the table initially.

MR. KNIGHT: And I'd have to answer it that taken out of context it may not, that one approach may not make sense. I think in concert with that you're always going to get the best cost benefit out of incrementalism as much as possible, as much as the market will bear.

The hybrid technology is expensive right now. So, again, from the customers' perspective to date they certainly are not -- they're seeing expensive cost increments, several thousand dollars that's, you know, real versus the gasoline. You know, they may look at a year or two or three's worth of return.

So all that has to be taken into consideration.

MR. WUEBBEN: So I think, perhaps, following on the comments of SMUD, the public may soon see that the cost of not doing it is much more expensive than doing it.

MR. WUEBBEN: Today air quality is a huge concern, is a dominant concern. And tomorrow will it be greenhouse gas or will it be price fluctuations or supply fluctuations. You know, that's the hard one.

But that will, I think, help dictate some of the strategies that make the most sense. It's not going to be a single focus, I don't think.

MR. GRAHAM: I'd like to add to answer that a little bit, too, from my perspective. I think the answer is you can do it in seven to eight years. I think the battery technology exists, the control system technology exists, the subsystems exist.

If there was a major effort to pull it off and put a vehicle on the street, I've ridden in both of the Honda and the Toyota hybrid vehicles. They're marvelous vehicles. The control systems are superb.

The battery technology is superb, it's here, it's been developed. Millions of dollars have been spent by EPRI and DOE and the auto companies to develop the batteries. It's a matter of a market size.

I'm absolutely convinced that you can do this in seven to eight years. It's going to take that long, of course, because you do have to go through the production engineering. You do have to go through the testing and all those things. It's not going to happen in three years.

But I would have to disagree with Ben. I think absolutely it can be done. And I think it can be done with systems that are on the street today that can be integrated, can happen. It's just a matter of putting the will behind it to make it work.

Giving now, given the fact that you give the auto companies a large enough market and give them the time to do the testing and the design correctly, and they will do it correctly; no question about that.

But that they give them the time to do the testing that's necessary. It can happen, and it can happen quickly. So I think it can happen; it's just a matter of saying we're going to do it.

MR. ADDY: Mike, I have a question.

MR. JACKSON: Yes.

MR. ADDY: My name's McKinley Addy; I'm with the California Energy Commission. I understand that the speaker who was to address potential efficiency gains for heavy vehicles using advanced technologies didn't make it, and I have not heard any of the speakers make any comments about potential efficiency gains in heavy vehicles using advanced technologies. And I wondered if the panel could address that deficit this afternoon?

MR. GRAHAM: I'll take the first shot at it, and then, Mike, you can add what you're doing.

EPRI is funding, with New York Power Authority, a project that General Electric is developing for a 40-foot transit bus. It's a combination of an ultra capacitor system, a battery energy storage system and an APU.

And the data out of the original test that had been done by GE in their lab, and the systems that they're currently acquiring show a significant reduction in emissions, a significant improvement in fuel consumption.

So we believe that there is a combination of ultra capacitor and energy storage system and an APU, managed with a very sophisticated control system that General Electric developed that can achieve this in heavy duty vehicles, as well.

And we do, in fact, are continuing that project. And are looking at step vans and shuttle buses. So we are moving in that direction.

SPEAKER: Is that a zero emission bus?

MR. GRAHAM: No, actually the first one's a diesel. I know you don't want to hear that, but it's -- but the emissions are significantly low. I mean there's some comparison against CNG vehicles in that particular configuration with the catalytic converter, the ultra capacitor and the energy storage system.

And that report is available now through GE, so it's --

MR. JACKSON: Just to add to that a little bit more, Bob, I mean the focus on heavy duty these days has really been on the emissions and meeting the 2007 standards.

But there is a number of hybrid studies on the heavy duty that are happening right now, including the ones that Bob talked about.

We're involved in a DOE sponsored heavy duty natural gas class A development to try to commercialize that kind of technology. For substantial fuel economy savings, especially in the downtown stop-and-go duty cycles, that you tend to get with pick up and delivery.

And, of course, you can get substantial

emission benefits with those kind of technologies, too. So, there is some of that happening.

There are a number of other vehicle type technologies, McKinley, that are -- DOE's investigating 21st century truck; road map will give you a pretty good idea of that.

Again, it's a systems type approach that you need to take, both the engine and the vehicle need to be put together. Most of the truck manufacturers would probably tell you the opposite of what you want to hear from the light duty people. To improve fuel economy on the light duty side you want to get them lighter, et cetera. On the heavy duty side they want to get them bigger and bigger and bigger, so on a ton/mile basis they're more efficient.

So, that's always a --

MR. MARK: If I could just add, we've done some analysis of what might be possible at the national, on a national scale of introducing advanced technologies and alternative fuels. I don't have the figures with me right now, but in principle it looks like, with a fairly aggressive introduction of let's say fuel cells into, perhaps starting with transit buses, moving to school buses, delivery vehicles. Diesel hybrid technology is also in the sort of stop-and-go driving, I think, that we've talked about.

You could begin to think about at least keeping greenhouse, or restoring greenhouse gas levels over the next couple decades back to where they were in the year 2000.

Again, the bar is high. You're talking about the majority of the energy use in the heavy duty sector coming from long-haul class A trucks that are incredibly well optimized. A fuel cell system perhaps as an APU offers you some advantages there because you reduce the opportunity or need for idling.

But the actual efficiency benefits of a hybrid drive train or a fuel cell electric drive train appear to be small, if they exist at all in that kind of driving.

So, the challenge, obviously, for the freight sector, which is -- whose fuel use is growing faster than the passenger vehicle market at this point, and then of course, freight is exceeded by air, which is not something we've talked about yet, but is a significant challenge at the rates that, until recently anyway, air travel was growing.

The freight challenge, I think, is significant in the 21st century truck initiative that the Department of Energy has launched. I think it makes a whole lot of sense, but it has, again, this same -- has the danger of falling into the same pitfall, that the partnership for new generation of vehicles did. Which is solely focused on, in their case, doubling ton/mile efficiency of heavy duty vehicles.

If they ignore the need to address emissions, then I think they're going to miss tremendous technological opportunities.

MR. JACKSON: I want to give Fritz an opportunity to summarize. And perhaps maybe in your summary, Fritz, there will be some questions that arise, too. So, could you please do that?

MR. KALHAMMER: Sure, and, of course, I'm trying to reflect what I heard. But it's also clear that my personal views are going to enter what I'm going to say. I'm also going to do a lot of over-simplification, both because of time and perhaps to make a few points.

First of all I agree with Jason Mark that I think we do have a very large opportunity with advanced technology vehicles to meet the efficiency environmental goals. I think these opportunities are real. Doesn't mean that they are going to happen, but I think the opportunities are there.

We also need alternative fuels, I agree with that, as well. Because every one of these technologies are going to require alternate, particularly those that have the greatest benefits, are going to require alternative fuels.

I think that we should remember, and I'm sure one of my own biases shows here, that the ultimate fuel for transportation, I believe, is electricity. Simply because it allows you to couple to any fuel that you want.

And when we think today about the uncertainties and risks that we experience because of our dependency on petroleum, which doesn't mean that natural gas is safe here, coupling ourselves to a variety of fuels in a flexible way from a strategic point has to be an advantage if we can do it economically. That, of course, is going to be one of the key questions.

Now, as to the technologies that we've heard about this afternoon, I would say first of all it's exactly the list of technologies that are the bona fide candidates to get us to our environmental efficiency objectives.

I don't think we've left one out right now that can be thought about, and that might upstage any of those that we've heard.

Now, the four that we've heard about, natural gas, then among hybrids those that depend on motor fuels only, and those plug-ins that also use electricity, I would say are two distinct categories in terms of evaluating their impact and their issues. And then, of course, fuel cells.

With the possible exception of the fuel-only hybrid, I think all the other technologies have comparably high potential with respect to both efficiency and minimization of environmental impacts.

The differences are not huge. There are some, but they are much closer to each other than they are to the fuel-only hybrid, and, of course, to the conventional vehicle.

So let me just say first approximation, all of these technologies can get us there from an environmental efficiency point of view.

The questions are then what are the

costs going to be; what are the special requirements going to be that might impede acceptance either in the market by the customer, or the establishment, or of an infrastructure that they will need. And what overall risk do they represent in some kind of aggregate way.

And here I would say from a cost point of view the natural gas vehicle technology clearly is presenting the least problem of these options. We know, and we've heard, that the fuel only hybrids look rather good. And I think can be competitive with conventional vehicles, particularly if their special advantages are monetized in one way or the other.

The plug-in hybrid vehicles clearly are going to cost significantly more, and there the monetization of specific, well, identification and monetization of specific advantages will be absolutely key; together with incentives in order to make a market for them.

And despite the fact that I've been a fuel cell advocate for longer than I can think of, I do think fuel cells really, particularly reformer type fuel cells, face a very difficult road in terms of costs. They are just so complex, and the technology is so sophisticated that getting the costs down to anywhere near competitiveness with conventional technology will be very difficult. I'm not saying it can't be done, but it is a huge challenge.

Now let's talk a little bit about risk. At first glance, again, where you take the technical and the market risk and the infrastructure establishment risks together, then natural gas looks pretty good.

The one concern that I have about natural gas is that if you have a wholesale shift to natural gas as a transportation fuel I think this is going to do things to the market that you don't even know.

Clearly, if you look at the studies that were supported over the years by the Gas Research Institute it shows that the resources will be more and more unconventional and can only be provided at increase in costs.

So if you create a huge new demand the costs are going to go up. How much, I don't know. But I sure would like to see better analysis than I see from the natural gas advocates of this particular issue, which, in my book is still very large. And you do have the vulnerability from a single fuel.

I think the coupling to electricity that the plug-in hybrid provides, together with benefits that are approaching those of electric vehicles, are very attractive. There the biggest risk is whether we can get the costs down to the point where this technology can be competitive.

With fuel cells I see several serious risks. The biggest one clearly is the high cost. But also if we are not learning how to build the reformer fuel cells for a reasonable cost, and establish the infrastructure of clean fuels that we're going to need for fuel cells, I think we are going to have great difficulties. Because I think hydrogen is pretty far in the future with the exception of fleet vehicles.

What that all says to me is that we have to, first of all, develop all of these options further. And then we have to look whether it is going to be possible to combine some of the attractive features of some of these options to create perhaps the winner.

Bob Graham was just talking about the natural gas engine, battery hybrids, which I think is one logical thing to think about. And maybe the ultimate, and Bob referred to that, also, might be a plug-in hybrid that has a fuel cell as the primary power source, because that will definitely reduce the cost of the fuel cell. It will reduce the starting problem, eliminate most of the problem that the fuel cell is going to be facing over the next five to ten years.

That, I would say, is my view in a nutshell. I do hope that ARB remains committed and the Energy Commission remains committed to the support of these advanced vehicle options, because I think all of these deserve support.

Considering their potential benefit, the costs of their development and they're furthering through policy is really quite small. And I think they have to become smaller yet, as one of the speakers was pointing out, in the context of what happened last week.

Thanks very much.

(Applause.)

MR. JACKSON: We're at 3:30. I think we're going to stop at this point, take a break for 15 minutes. Dan, is that right?

MR. FONG: Yes, I think we're going to

take a ten-minute break.

MR. JACKSON: Ten minutes.

MR. FONG: And all of the speakers for the next panel who need audio/visual assistance, please come forward.

MR. JACKSON: And if the audience could thank all the panel members for their participation, I'd appreciate that.

(Applause.)

(Brief recess.)

MR. WUEBBEN: Thank you very much. I know we're trying to cram a lot of information in a short period of time, but that's the kind of age that we're living in now, I guess, trying to do the best with maybe less resources than we had assumed.

This is the beginning of panel three, emerging transportation fuels. And I think just as a brief background we're really looking for these panelists to provide us with as much pragmatism and clarity of what individual fuels can offer us as we look to displace certain volumes of petroleum use.

We're particularly concerned about getting as much focus, if you will, in their presentations on the scope of the fuel supply, the infrastructure costs that might associate with that. I think we're just waiting for this repair down here.

But, if I can turn to our first presentation. Sean Turner is the President of the California Natural Gas Vehicle Coalition. And, Sean, are you able to do your presentation from here?

MR. TURNER: Can everybody hear me in the back? Great.

Thanks very much, Paul. I am Sean Turner; I'm with the California Natural Gas Vehicle Coalition. I know the day is, you get over seven hours a day, starting to get a little bit longer. I appreciate those of you who stayed and hanging in there with me. And I'll try to stay to the ten-minute deadline on the presentation.

I think I would be remiss if I didn't tell you that we've got, especially the topic of my presentation being market potential, if I didn't say that we have over 40 member companies, gas utilities, fuel suppliers, auto manufacturers, engine manufacturers, all the way down to fleets, who strongly believe that natural gas is a viable transportation fuel with significant market potential. That's my one plug for the afternoon.

Next slide, please. I came on board the Coalition earlier this year, lucky enough to be right in the middle of an energy crisis with a whole bunch of questions being thrown at me right from the start. And unfortunately right at the beginning I had very few answers for those.

Probably one of the biggest questions that comes up, and before I can discuss market potential for natural gas vehicles, I think I need to hit this one. And that is can we afford a significant penetration of natural gas vehicles with the current supply constraints.

You know, people are concerned about we're building new power plants here in California at a new or remarkable rate. Are we going to have gas available for natural gas vehicles.

So I decided that I needed to answer that question for myself before I could get up here and speak with this group.

So I went back to the data this past week, I went back to the experts, of which I am not one of them on gas supplies. But I wanted to go back to the data that was available out there.

And so I went to DOE's Energy Information Administration, the American Gas Association, and the Gas Research Institute, looked through their reports to see where we stood as a nation on gas supply.

Next slide, please. I just want to give a brief update on where we stand right now for most of you who, I'm sure, are not real familiar with this. And I wasn't terribly familiar with it before I started the process.

So our current U.S. annual consumption of natural gas is about 22 quads. If you do know what that means I'd be surprised. A quad is a quadrillion Btus, 10 to the 15th. I know that doesn't have a lot of physical meaning, and a few slides from now I'll get to explain what exactly that means.

Eighty-five percent of our U.S. consumption is produced domestically; 13 percent from Canada, for I would a pretty astounding number of 98 percent of our gas coming from the upper part of North America. And as we spool up gas supplies in Mexico I expect we'll see even more North American gas being used here in the

U.S.

Current estimates, which I'll explain here in a second, have been increasing for the last decade. Project domestic supplies at over 60 years here in the U.S. and over 100 in Canada.

And as the years go by and we develop new methods for gathering natural gas, the gas supply projections have been increasing. So for the last decade while we have used a large amount of natural gas each year, our total supplies have actually increased.

And that's because we're discovering new ways to extract those from the ground, or discovering new supplies in other parts of the nation and the continent.

Next slide, please. On the natural gas pricing side, the three organizations I mentioned earlier agree on a couple different things. One is that our current consumption of about 22 quads per year of natural gas is going to increase to in excess of 30 quads by 2015.

And that that demand can be supplied with modest price increases with domestic production. We're not going to be increasing our foreign importation from the roughly 2 percent we're at now to meet these demands. We can meet them domestically.

And it's a bit of an eye chart there at the bottom, and these will be available after the presentation, but basically what the small text down there says is that while we're in the range of about $2 per million Btus today -- don't hold me to the exact numbers. It was about $2 and 20-some-odd cents last week.

But from that range we're going to see modest increases in a range from $2.30 to a little over $2.60 per million Btus over this next 14-year period. While those increases are significant in the total picture, the estimates also say that the experts predict that the residential and commercial prices for the gas will actually remain constant, if not decline, in real terms.

Because while the feedstock process is going to go up, our efficiency in delivering them to the end users is improving all the time. And so the total cost to the end user might not change at all. And potentially even decline in real terms.

Next slide, please. So now we get to the NGV case, and where it fits in with the last couple of slides. Again, our U.S. consumption is expected to go up from roughly 20 quad, we're now 22, to over 30 in the next 20 years without major supply or price constraints.

That's not to say that it's not going to be difficult, don't get me wrong. But the people who, you know, the reports I'm looking at from the agencies who know this material best, don't seem to think we're going to have issues that are insurmountable in providing that supply at the price projection points I was talking about in the last slide.

As a matter of fact, this is where it gets a little bit interesting, American Gas Association put out a report last year called fueling the future, which estimates that NGVs could use up to 1.5 quads by the year 2020 and still remain well within this pricing forecast that I just showed on the last slide.

Now getting to the part where we'll try to put some definition to what 1.5 quads means. 1.5 quads is approximately 12 billion gallons of diesel fuel. I think that helps people understand a little bit about what this means, and that's, you know, $10-plus-billion in foreign exchange not leaving the United States to purchase this type of fuel.

1.5 quads is also approximately the fuel consumption of 1.5 million refuser haulers on the road. Now, that's a pretty outlandish number considering we only have about 17,000, 18,000 refuse haulers on the road here in California. We're not going to need 1.5 million refuse haulers.

But the example, you know, proved to myself, really, was that we can absorb a great deal of penetration in the natural gas vehicle market inside of the current estimates, inside of the current supply and pricing estimates. And 1.5 quads also represents approximately 26 million Honda Civic GXs. So we're talking about a large number of vehicles being put on the road in the next 15- to 20-year timeframe with no change from current projections in gas supply present.

Next slide, please. As Mike Jackson was saying earlier today, our initial NGV efforts have been poor. Arguably that's the reason why we're here in the emerging transportation fuel section.

You know, it's kind of funny when you look back and realize that the first internal combustion engines ran on gaseous fuels. We started trying to implement natural gas vehicle programs back in the mid '60s. Yet, our penetration and our success has been fairly low.

I think a lot of that has to do wit somewhat low fidelity approach we took in the past. It's, you know, put stations out there and people will come. And we found out that didn't work.

We could argue a number of other reasons that we've had problems, but this is just an example of one of the things that has been an impediment.

And the other results is now we have a relatively large number of fueling stations around the U.S. with very low utilization, and accordingly, poor economics at those stations. The people don't want to keep running them.

Next slide, please. So where are we in California right now? California has somewhat become the model for the natural gas vehicle market around the U.S. And I'm going to explain the reason why.

We currently have about 20,000 NGVs actually using the fuel in California. We have over 200 fueling stations. And every major auto and engine manufacturer has at least one product in this range.

Next slide, please. The reason we've had some success here in California has been the approach we've taken. My presentation is entitled market potential, but in reality I think it's probably more appropriate to say what our initial market potential is, because natural gas vehicles, because of the necessary infrastructure needs for NGVs, we have to choose our markets carefully.

We talk a lot about the medium and heavy duty vehicles when you listen to natural gas vehicle companies speaking about advantages, disadvantages. The reason they tend to do that is that those vehicles can see the market with natural gas fueling stations. They're the ones that companies can afford to install public natural gas fueling stations for, given those anchor tenants of medium and heavy duty fleets.

And then those public fueling stations are available for an expansion in the rest of the market at essentially, well, at very low cost.

So here in California our member companies have tended to target five different fleet applications. You can see here refuse collection, transit, airport taxi and shuttle services, pick up and delivery vehicles as well as school buses.

Next slide, please. This is one that really shocked me earlier this year. Approximately 100,000 natural gas vehicles here in the United States. We have about 21 percent here in California. While that's a bit disproportionate, based purely on population weighting, we are the largest state in the union, we have more than 10 percent of the population. So it's not shocking that we have more of the NGVs.

Next slide, please. This, on the other hand, does show disproportionality. What this shows is that our 20 percent of the vehicle fleet in the U.S. uses 51 percent of the natural gas in the United States. And I'll let that settle for a second.

I mean we're using over half of the natural gas for natural gas vehicles here in California. People are actually using those stations, using those vehicles, a large amount.

Next slide, please. So, one of the

reasons for that last slide, and one of the reasons we see that increased usage here in California is that, what I was saying a couple slides ago, I got ahead of myself a bit, is that as those additional fueling stations become available for those larger fleets, the cost of implementing NGV programs in other fleets, and for individual consumers, drops immensely. And people are willing to move into that marketplace.

We hear it all over. From Honda is a great example. People willing to buy GXs; they want to use HOV lines, they want to be doing commuting in these vehicles for any number of reasons, and now they can. And that's something that our strategy for market implementation here in California has made possible.

I threw this last blurb in there because, you know, this is something I feel absolutely unwavering on. NGVs are the only option that leads to true petroleum independence and environmental improvement.

Next slide, please. So what are our future priorities? To continue this effort in California, because I wouldn't say we're, by any means, even close to a mature state yet, but we're going to stay on the path that we've already found. It seems to be working quite well. And that's staying focused on the fleets that we know can get the market started.

And hopefully continue it on for a wide range of fleet applications that do not have access to natural gas vehicle market right now, but could potentially have access in the future.

Probably the things that our industry is focusing on with a great deal of support from ARB and CEC already is try to increase the number of natural gas medium and heavy duty engines that are available.

We have a relatively small number of engines available in the market today, and that limits the number of vehicles that we can put out there and the applications that we can put them into. That's something the industry is working very hard on. As well as I say increased chassis integration here, that's, you know, the number of different applications that are available with natural gas powered engines in them. That's something that we're trying to increase as quickly as possible.

And then on the liquified natural gas

side, I haven't talked specifically about CNG or LNG. This is one of the major priorities, though, for the industry, as we move farther into liquified natural gas vehicle applications, is building an infrastructure that can allow access of all vehicles; you know, common refueling nozzles and receptacles; cryogenic metering systems and things that make increased usage of LNG possible here in California and the U.S. And for that matter, worldwide.

Charles is going to talk more about the LNG side of it, but that is a critical link that the industry is working hard on and we'd like to see continued support from CEC and ARB going forward.

MR. WUEBBEN: Great. Thank you very much, Sean. I'm sure we'll have some questions at the end. I have some supply questions. But in the interests of time, our next presenter representing Mutual Propane, or actually the Western Propane Gas Association, is someone who is replacing Steve Moore of Mutual Propane who was not able to be here this afternoon.

Rob Scott is the HAZMAT Training Director for the Association, and welcome.

MR. SCOTT: Thank you, Paul.

Good afternoon. Steve wanted me to convey his thoughts to you today, and they are that about 90 percent of the propane comes from within North America, because the majority of propane comes from the fraternization -- tough word -- of the natural gas liquids.

More propane vehicles in the U.S. and California than any other alternative fuel. There's currently enough propane for every fleet vehicle in the United States. Today propane is the primary and fleet fuel. We foresee a good supply for the next 20 years and beyond.

The trend towards modern fuel infrastructure is fleet on site, and some new ideas called Clean Fuel USA. What Clean Fuel USA is, is a concept of utilizing current refueling gas stations by placing propane refueling stations on site that can be accessed 24 hours a day, as well as utilizing credit card service. So therefore we're using the land without taking additional land for the refueling sites.

The propane over-the-road vehicle counts for less than 1 percent of the market today. The market could expand a 10 percent of gasoline usage without impacting the price or supply. The fleet market is a niche market, but it is a big niche.

Now, I've been in the propane industry 20 years, and I'm sad to say that I have watched companies, Sears, Frito-Lay, and numerous that were fleet accounts that ran their entire fleets nationwide on propane go away from it.

And they went away for a couple of reasons, but the main reason they left was that they couldn't get the vehicles that were on propane. Because at the time they went away the OEM program was not in place. And they weren't allowed to retrofit. And that was a large market.

They consume a lot of fuel and are good candidates for emission reduction through the use of propane fuel.

Propane is competitive now as a fleet fuel with prices running 25 to 50 percent less than regular unleaded gasoline on a gallon-per-gallon basis. Even though propane octane is a minimum of 104 at the dispensing station.

Propane is competitive now against other fleet fuels driving 20,000 to 30,000 plus miles a year.

The focus should be put on the vehicle;

the infrastructure is already there. I hear talk of how do we develop refueling sites. Every propane plant in the United States is a refueling site because we operate our fleets on propane when we can find vehicles that we can operate with.

The infrastructure will follow and continue to grow such as the Clean Fuel USA. Additional vehicle incentives are needed, though, to help the process.

What we repeatedly hear in the southern California region on the vehicles that have been purchased through the OEM basis because they are bi-fuel, that they don't qualify for the carpool lane without two people in it. It could help if they could qualify for that carpool lane, even though they're bi-fuel.

We plan on getting more vehicles to the marketplace in three ways. We strongly support the OEM marketers. We do a quasi-OEM propane vehicle program that gets vehicles to the people that they actually want sooner; not the three to five years that it takes in the development process now.

And we introduced the certified new high technology aftermarket system for new and used vehicles that meet the ULV emission levels.

There are people that are willing to use the propane. I grew up on a farm, and our farming neighbor had 75 vehicles on the farm that ran strictly on propane. And like I said, when the conversions went away and the retrofits went away, that business went away. And it's really sad because my family's been associated with the propane industry for 50 years. And we've always drove vehicles on propane. And now it's almost impossible to get them.

MR. WUEBBEN: Okay, well, we appreciate those comments. Our next presenter who is a specialist in liquified natural gas is Charles Powars, who is a Partner of the Research Partnership. So, Charles, welcome.

MR. POWARS: Thank you. Sorry the print's a little small. The work I'm going to be reporting on is the initial part of a little project we're doing for the California Energy Commission. It looks at the supply and the demand of LNG, in particular. And listed there is a whole bunch of organizations that have helped us by providing data or information.

What I'm going to do is give you a quick overview of where LNG fits as a transportation fuel. And then how much of this fuel we're consuming, and we think we'll consume in the future. And then where we think it will come from.

Okay, the niche for LNG is obviously heavy duty trucks and buses. This is because first and foremost the economics. The fuel itself, at least right now, and in most of the past few years, the fuel, itself, costs less than diesel fuel, even when adjusted on an energy basis. And so we can use this to amortize the incremental capital costs of the equipment and, in some cases, with no incentives; in most cases we need some financial help in doing that.

And the second is the air quality benefits, which most of you are aware of. They're particularly important for heavy duty vehicles, as most of you know. The payoff is very high in that segment.

In California there's roughly only 4 percent of the vehicles are heavy duty vehicles, but depending on exactly how you do the counting, they account for somewhere in the vicinity of 50 percent of the NOx and particulate emissions.

And the heavy duty natural gas engines are available that do have low NOx and low particulate emissions compared to diesels. The point there is that we've got over 20 natural gas engines that are certified to the optional CARB low NOx standard. I believe there's zero diesels that are certified to that standard.

Also, as other people have pointed out, the carbon to hydrogen ratio of methane is a low greenhouse gas situation.

And if you can do the next slide. Obviously there's energy diversification benefits which is the reason we're here today.

Next, compared to some of these other things that are very promising that we're working on the technology is basically here today. It's ready, it's commercialized and it's available for purchase. OEMs are offering equipment. You can buy heavy duty natural gas engines that are emission certified from OEMs from about 150 to 400 horsepower.

And finally, the LNG technology obviously is fairly well suited to a heavy duty fleet environment. Mainly because the relatively high fuel density both on an energy basis and on a volumetric basis, has a minimum compromise of payload on either a bus or a truck.

Second, there's no question the fueling procedure is a little bit more complicated, but not all that complicated. And it's well suited to fleet refueling environments. And that fact that fleets tend to use their vehicles regularly, as opposed to park them for a few weeks or months when they go on vacation, makes it better suited for LNG.

Let me show you a few examples. Just a couple of quick examples of what kind of vehicles we're talking about. This is the shuttle buses that are used at the Los Angeles Airport. These have been in service since 1994. If you've ever had to switch airlines at LAX where you had to go across the U, you've probably ridden on one of these LNG buses. I should add that these buses are manufactured in California by Californians.

Next slide, please. The class A tractors such as used, in this case, by Raley's for their grocery distribution are another example. Raley's is a pioneer fleet. They've been operating ten LNG trucks here in Sacramento for a few years.

Next slide. Our biggest transit bus fleet operating on LNG is the Orange County Transit Authority. They have 61 LNG buses operating now. They have 270-something more on order. Just a little highlight. Even LNG takes just a little more room, and that's what accounts for the little hump in the back of the bus. Because these are low floor buses.

Conventional buses, it's easy to get the LNG tanks under the bus, just like a diesel tank. For the low floor buses, it's a little more complicated.

Next slide, please. Another example of a heavy duty truck fleet is Harris Ranch down in Coalinga. Been running about a year. These are Freightliner trucks with Caterpillar engines.

Next slide, please. Probably the fastest growing segment is the refuse collection and transfer. This is waste management LNG Mack trucks in El Cajon that are operating on LNG.

Next slide, Dan. And waste transfer trucks are the ones that take the waste from where the collection trucks drop it off, and take it to the landfill. Typically they're just basically class A tractors. This is some class A tractors that are being purchased by Norcal Waste in San Francisco.

The point of these pretty pictures was basically to kind of show, in this narrow niche of LNG heavy duty vehicles, these are not only vehicles on Vugraphs, these are vehicles on the road today.

And so the Energy Commission was worried about how much fuel they're consuming, and where that fuel's going to come from, and that's what I'm going to talk about next.

Okay, I realize this is hard to read. This is basically a number of vehicles versus year and the current time is right here. And this is the growth. The black section is just real data. We currently have a little over 300 LNG trucks and buses operating in California.

The red section is actually not really a projection. That's the number of vehicles that are on order or commitments have been made by truck and bus fleets to purchase those vehicles.

Incidentally, that may look like a straight line to you, but it's really high science. It's a huge spreadsheet behind that with intricate things. I was almost tempted to tweak the numbers a little bit so it looked like it had more character to it.

Extrapolating that, actually it's more than extrapolation, adding a projection based on some history we can see that if this trend continues that this is a rapid growth situation.

Next slide. Before we compute how much LNG we're consuming we have to add the CNG vehicles that use LNG. Sean, I think, briefly mentioned that. But most all the new stations like the Tulare station that's opening tomorrow, which incidentally if anybody had time to stop by they can see an LNG station and some LNG fleets.

All the new LNG stations seems to also have LNG to CNG capability. And so we have to add those vehicles.

And then finally, if we multiply these vehicles time show long they drive, and divide that by how much fuel they consume, we get the following chart.

That one, yes. This is the projected LNG consumption. Right now we're using a little less than 20,000 gallons a day in California. The black line is my projection. AZUS Development made a projection a couple of years ago which is kind of similar to what I came up with.

The folks that actually sell most of the LNG, applied LNG technologies, made a rough estimate for me. And that agrees pretty well, also.

So it gives us some basis that when we compare this to supply we're at least in the right ballpark.

Dan, the next slide. Talk about LNG supply, let me talk a little bit about the economics, because just like we're trying to get people to invest in vehicles, we're trying to get people to invest in this business, as well. And so we have to say something about the economics.

A greatly simplified view of LNG economics is simply that the feed gas costs plus the liquefaction cost, both the cost of the liquifier and the cost to operate it, plus the cost of transporting the fuel from the liquifier to the station, adds up to the delivered LNG costs.

The interesting thing is, in my view, these are kind of like wrinkles in the carpets, because there's a lot of clever ideas for pushing one, or even two down, but nobody's figured out a way to push all three down simultaneously.

Let me talk about transportation costs first. Dan, the next slide. LNG is transported in tank trucks that look a little bit like gasoline and diesel trucks except they're vacuum jacketed to keep the LNG from vaporizing too fast. They hold about 10,000 or 12,000 gallons.

Next slide. This shows the current sources of LNG in California. And I'm going to, in a subsequent slide, talk a little bit more about them. Most of the LNG comes from one plant right at the California border and Arizona. We call it Topock plant. It is operated by this company, ALT-USA.

There actually is a very small plant a little north of here, we call it Quadren plant, that has a low production in services, mainly the specialty gas market, but has provided some transportation fuel LNG and may expand.

When Quadren is over-subscribed or unavailable, LNG is trucked from Wyoming or New Mexico, or even from Kansas.

Next slide shows the stars indicate the various projects that are either under way, or at least in the talking stage. And most all of those are in California to provide additional sources of LNG.

Next slide. Okay, let me walk through some of those. The first one and the main one that is current is this plant in Topock. The plant, itself, that thing there is a liquifier, is actually owned and operated by El Paso Gas.

ALT-USA owns and operates a loading facility at the same location. And it has a capacity of 86,000 gallons a day, but it has to support three different things.

It supports transportation fuel; it supports various industrial users that are typically people that, I believe it's a close call between propane and LNG for some of these things like kilns. And so they're a big demand.

And then finally they support some municipalities that are committed to provide natural gas service, but don't run a pipeline, like San Diego Gas and Electric never has run a pipeline to Brago Springs. And for decades it's got its natural gas from vaporizing LNG.

Now, there's these other plants that I showed in further away states that have supported LNG. I won't explain those in detail. And in almost all cases they are plants built for another purpose like so called nitrogen rejection units, or gas separation plants to actually generate the propane.

But in those cases it's very easy for them to co-produce LNG. And they can do so at a pretty low cost. Unfortunately, they're not in our state.

Next slide. Now, these are some of the developments in process. Pacific Gas and Electric and SoCalGas are working with the Idaho National Engineering and Environment Laboratory to develop a turbo expander style liquifier, which, in a nutshell, saves a lot on the operating cost of the liquifier, because it depends on a pressure drop.

And those are going in, the first one is getting ready to be installed here in Sacramento. They're very small. They're about 5000 to 10,000 gallons a day. An outfit in Washington State is developing even smaller, almost skid-mounted liquefiers. This is a photograph of one of theirs. They're called cryofuel systems. And they work from landfills, from flare gas sources, that kind of thing.

If we get kind of further into the

future, in the next slide these are some potential sources. The City of Long Beach runs its own gas utility. And they're very much engaged in natural gas vehicles, and they're planning to build a liquifier.

Quadren, which I mentioned up here, liquifies very high nitrogen gas with a special process. They think they've got some additional gas reserves located, and they're looking for financing to upgrade so they can get in the transportation fuel market.

These liquefiers that I mentioned, the turboexpander liquefiers and landfill gas liquefiers, if the initial projects work well, they're committed to install many many more of those in the state.

The next slide. Finally, there's two a little bit further out cases. That says I'm supposed to speed up, one minute, please, okay.

(Applause.)

MR. POWARS: A peakshaving plant that would be integrated with an electric power generation station is being looked at. In that case, since we all know that all new power plants are going to be natural gas plants, if they can have an interruptible power supplied by liquefying and storing LNG, it makes their picture look better. It also can co-produce transportation fuel.

And finally, there's been two import terminals that have been announced, which will have a huge potential, but also have some challenges.

One is they have to believe this is a market. They have to get permitting to get the import terminals. There is one that's already pretty much committed in Rosarita, a little south of Tijuana.

There's some additional challenges because they have to process the gas a little bit because of methane content. Excuse me. The Australian gas is a little bit too low.

Next slide. This will be in the proceedings, but what we've done is we've taken that projected consumption and compared it to the supply. This is the existing supply here from Topock. Allowing about a third of their total capacity to California.

This is what would be provided by the additional smaller facilities that are coming on line. The reason for this kind of funny graphics is it's hard to figure out exactly when they'll come on line. The initial part is when they're planning to come on line. The truth is that history has shown that those have a way of kind of slipping. And so this is kind of a diffuse lines comparing.

The point of this is that unless they're right on schedule, we're going to have to import some LNG from the Wyoming area in order to support this growth.

Next chart. If we get a little further out with some of these other things like the Long Beach facility, and if those can happen as fast as they plan and the Quadren can expand, it looks like it ought to support the growth in the out years.

And actually this has all of them there. You skipped one, but that's all right. You're helping the time here.

Up here, which you can hardly see, is the potential for only 5 percent of the Rosarita import terminal if that can be made to happen.

So, the final slide, the point is that LNG fueled trucks and buses are fairly real. The economics are real. The emissions benefits are real. The equipment is on the road today.

LNG consumption in California is increasing pretty rapidly. And there's a concern about how we're going to keep up with the demand. And new California LNG sources are needed, and they need to come online within about a year.

Thank you.

MR. WUEBBEN: That's great. Thanks very much, Charles.

Our next presenter is someone I've known for a long time, Neil Koehler from now Kinergy Resources is here to talk about ethanol. Welcome.

MR. KOEHLER: I just want to give a, Paul asked me, overview on, you know, the overall supply and demand on ethanol and some of the opportunities here in California, which are very significant.

This slide is the obvious one, why we're all here. Crude oil imports, gone up obviously very considerably, while our U.S. production has declined. So, as U.S. oil production has declined we have not switched to other domestic fuels, but have relied more and more on imported oil. And I think certainly the events of last week just one more time make it obviously clear on why we need to do something about that.

Next slide, please. Paths to reduce the hazards of petroleum dependence. I think it's important to kind of have an overview of, you know, what the main threats are that we have to keep the eye on.

Conservation. That's number one. We have to reduce the amount of fuel we use. And I think it was appropriate to have those panels first talking about the efficiency improvements that we have to make.

It's, you know, in my view, that we can reduce half of the liquid fuel demanded by those very aggressive efficiency improvements. So I mean that is job number one is don't use as much. Both through habits, which I guess we'll learn more about tomorrow, and through advanced technology.

Fuel diversity. Just like any natural system, it's sustainable. We need to be diverse. We need to have a variety of technologies which we're seeing developed. And we need a variety of fuels.

So while, you know, we all can be up

here pitching our fuel, I think everybody would agree here that the more the merrier. Somebody said earlier we need to do a little bit of everything. I think we need to do a lot of everything.

And so every fuel here represented has a very important role to play. We all need to work together to be part of that diverse mix of fuels.

Renewable fuels. That's certainly my angle with ethanol. Biodiesel certainly meets that grade, as well. But as we look towards the future it's critical that we not only use less fuels, but the fuels that were left using are renewable.

Ultimately that is the only way to tackle the sustainability issues, climate change issues that are becoming paramount.

And energy independence kind of runs through all of these. That's making sure that whatever the fuels that we're left using, that we have control over. And I think that's something that you see in all of the alternatives represented here, that, you know, either produced in the United States or North America.

Or in other parts of the world, say in

the case of ethanol, Brazil, which is certainly a potential for supplying secure sources of ethanol to California and the United States.

Next slide, please. The key attributes of ethanol. It improves air quality, reduces all criteria pollutants both in blends and in its more pure nature.

Renewable fuels we discussed. Part of fuel diversity. And diversity with ethanol, I have a slide later talking about it. But it's more than just the fact that it's something new that's not related to petroleum. It's renewable, but there are so many things you can make ethanol from. Any starch, sugar, cellulose, alcohol, I mean all sorts of raw materials that we can make ethanol from which makes it very diverse on both the production and the use.

Versatility, I think, is a key characteristic of ethanol, to make a contribution today, as it is in a very clear fashion, and in the future.

Gasoline blends. There was a comment this morning which I heartily agreed with by Mr. Jackson that the oxyfuels program has been the only viable strategy for introducing alternative fuels. That's what has fueled the growth of ethanol in the United States, is various clean air requirements over the last number of years that has very dramatically increased its use. And that obviously has been an alternative fuel and something that has displaced petroleum.

E-85. There will be next year over 150,000 vehicles in California, and over 1.5 million in the United States that can run on up to 85 percent ethanol. There is the whole problem with distribution and we're not going to solve that problem here today. We need to think creatively on how we get more ethanol to the consumer.

But just the fact that those vehicles are out there, from an energy security standpoint alone, is a very positive thing. That if we truly had a very immediate problem, and a very immediate need to do something differently, we're developing a lot of vehicles out there that can run on a variety of fuels. And that's a positive.

Fuel cells. Ethanol, along with other fuels, is a very good source of hydrogen. And certainly over the longer haul we will see a lot of ethanol use in fuel cells. And so it's just a very versatile fuel.

Local production. I think that that's also critical in looking at the opportunities in California is we can produce a lot of ethanol here in the United States, as well as all other states in the United States, as technology to convert cellulose emerges, and certainly in many other North American regions, as well.

Next slide, please. A little history on the growth of U.S. ethanol production starting in 1979 through the year 2000. Obviously a very steep growth there from under 200 million to last year 1.6 billion gallons. We're on track this year to produce 2 billion gallons of ethanol.

So we're seeing a very dramatic increase in the production of ethanol. All primarily from corn in the midwest. But more opportunity to produce ethanol from other raw materials as I'll discuss in a moment, are clearly available to us.

Next slide. This slide is from a very recently produced report from the Energy Commission. They have done the most up to date survey on future ethanol capacity over the timeframe from 2001 and 2005. And this was to get at the whole issue of ethanol availability to meet the timetable for phasing out MTBE.

And as you can see here what the Energy Commission has concluded from their survey is that the steep growth in production that we have seen in the past is just continuing to ramp up to where projecting a doubling of ethanol production from 2001 through the year 2005. And the chart there breaks it up between the various plants. New plants, expansion of existing plants, and then new plants under construction.

So a very excellent report. I would encourage anybody who wants more information on this, breaks it out by areas of the country and talks about other factors related to the supply and demand on ethanol as it relates to the MTBE equation. So, lots of new growth. Lots of crude oil that can be displaced.

Next side, please. On the demand side this is also from that same report. You have the past, there has been ethanol used in California to meet some of the air quality regulations. Primarily it's been the use of MTBE, and that's why you see under future A and future B two very dramatic increases in the demand for ethanol in California.

A is 6 percent, which is to meet the federal Clean Air Act. Oxygen requirements, that's the amount of ethanol that is required, and 70 percent of California today would require that. And then if it were to be extended to all of the gasoline, that's the higher number at 900 million gallons.

So if we get to 900 million gallons out of projections in 2003, I believe, of the ethanol in excess of 3 billion, it's a significant chunk. But I think the conclusion has been from the Energy Commission that there is available supply to meet these very near term needs.

And that's good news, as we move forward and think about more aggressive goals on displacing petroleum and introducing renewable fuels, is that due to air quality regulations we're seeing a very rapid increase in the production and use of ethanol in California.

And that's good news from an air quality standpoint. It's also good news as we move forward and try to introduce other new fuels and new uses for ethanol and other replacements for crude oil.

Next slide, please. Just an example of

all the things that we can turn into ethanol in California. I mean it's over 90 percent is corn today, but with the technology through enzymes and acids to break down cellulose. And that technology is getting very close to commercialization.

The Department of Energy and the State Energy Commission have been putting a lot of resources into moving that technology closer to commercialization. That opens up, obviously, all sorts of both waste and primary products from the forestry, from urban, you know, rice straw and forest thinnings would be two of the early entrants here in California that have the opportunity to produce significant amount of ethanol.

And there's a lot of food and beverage waste that are currently turned into ethanol. And that's back in my prior existence with Parallel Products. Those were some of the things that we turned into ethanol here in California, Rancho Cucamonga, California.

Next slide. A little hard to read. This is from another CEC report from '99, biomass to fuel, ethanol potential in California. And what they did, just to get an idea of what the available raw materials were, took all of the various waste biomass, and this is excluding the conventional crops that you can turn into ethanol. So really looking at that cellulose opportunity.

And if you converted all of that waste into ethanol it's that number on the far right with some of the more improved technologies, there would be enough for almost 4 billion gallons of ethanol.

So obviously we're not going to turn all that waste into ethanol, but that just gives an example of just from waste cellulose what the opportunities are. If you add to that the conventional crops, we now have corn farmers in California that are gearing up to build ethanol plants. There are sugar cane growers in the Imperial Valley that are very interested in producing ethanol in California.

So if you start, it's a primary cellulose. It could be grown on marginal lands, switch grass, poplars, trees like that. The number can be very large.

Next slide. Pricing obviously of interest to everybody. This is a graph from March of 2000 through last week; it's tracking the spot price for gasoline, MTBE and ethanol.

The ethanol number is normalized with the tax credit, which is taken by the blender, so the real cost to the consumer and cost to the blender, it take the tax credit into account.

And you can see that ethanol has been lower than both gasoline and MTBE in that period of time. And frankly, if you ran that graph over the last 10 to 20 years you would see the same thing.

There have been concerns that as we ramp up the use of ethanol so dramatically that we might see that, see some price spikes and price volatility. All I could say is that I can't read the future. But if you look back at the speed at which ethanol has ramped up in production and demand has grown, and we have not seen that in the past. That would suggest that we should be in pretty good shape as we move forward.

The one thing I find rather interesting is that, and this has also been true of longer than the timeframe indicated here, is that there's less price volatility with ethanol.

You see gas having, really displaying

probably the highest price volatility. You know, we have concerns about 50-cent increases in the price of gasoline. Well, in the last four weeks the price of gasoline has gone up 50 cents at the wholesale level in California. So I mean that happens all the time in the gasoline world, 50-cent changes.

Next slide, please. Net energy balance. There's a lot of mythology around how it takes more energy to produce ethanol than you get out of the ethanol, itself. This is a very good slide. It was also from the CEC biomass potential report.

It looks at the net energy balance issue. And as you can see, corn to ethanol, where most of the ethanol is coming from today, less than 50 percent fossil fuel used for the energy received.

Obviously the one that uses the most fossil energy per Btu delivered is gasoline, itself.

Next slide. There are concerns about impacts on the federal budget for the tax incentive, which does amount to 53 cents a gallon. This was done by Kellogg School of Management, where they concluded that for the 600, and this was some years back, so the numbers would be larger, but the savings would be the same, is that when you consider increases in income and declines in the state, the federal payments on crop subsidies, et cetera, is that there is a net savings to the federal treasury in incentivizing ethanol production and use.

Next slide, please. This is also from the California Energy Commission report looking at, you know, want to get quickly to how we can produce ethanol in the State of California.

Like many midwest states, they provided significant incentives. And this was modeling what if the state was to provide 20 percent capital and 40 cents a gallon producer incentives for ethanol producing in California, looking at less incentive at 20 cents and 10 percent.

And what you see there is that the net benefit, particularly if you look at the middle one, which frankly, I think, would be sufficient to develop a very robust ethanol production industry, that for every dollar invested, public investment by the state, it would return $3 in economic direct, and then some resource benefits there, to the state.

So, a very very positive return on investment, and obviously achieving goals of petroleum displacement.

Next slide. This was --

MR. WUEBBEN: Neil, are you about to sum up?

MR. KOEHLER: Yeah, this is the last slide after this one. This one was, you know, say if we wanted to get aggressive we could produce 4 billion gallons of instate ethanol by the year 2015. Is that a practical number, is that a cost that, you know, at what cost? I mean those are all questions.

But I think it is a brave new world and we need to look aggressively if we're going to make any progress.

Next slide, please. Policy recommendations from the ethanol front. There's cost of legislation, SB-87 that would provide producer incentives. It's now a two-year bill. We think, and there's a broad coalition of farm, environmental and government support for that bill.

A renewable portfolio standard we've talked about on electricity. There's conversation about at the federal level on fuels. As far as I'm concerned energy is energy. We should have a renewable portfolio standard for all energy whether they be electrons or molecules.

And CO2 regulation, the Pavley bill, AB-1058, was referenced. I think that would go a long way to providing incentives for efficiency improvements and address the climate change issue.

So those are the three policy recommendations, and thank you very much.

MR. WUEBBEN: That's great, thanks very much, Neil, appreciate you trying to package that.

Our next presenter is Greg. Didn't mean to overlook you there, Greg. Certainly you've come a long way and we really appreciate it. Thanks.

MR. DOLAN: Sure. Good afternoon. I'm with the Methanol Institute. The Methanol Institute serves as the trade association for the methanol industry in the United States. And I'm going to try to challenge Dan's fast fingers here. If you could skip the next two slides, skip one more.

Great. Automakers have shown that by the year 2020 fuel cell vehicles may represent something in the neighborhood of 7 to 20 percent of all new car sales.

So we can estimate from that that the global fleet of fuel cell vehicles could be somewhere around 40 million vehicles on the road by 2020.

Next slide. What would that mean if those vehicles were largely fueled with methanol. By 2010 if you have a half million methanol fuel cell vehicles you need roughly 218 million gallons of methanol per year, which is less than 2 percent of world capacity.

Right now there is over capacity of methanol production in the world, enough to fill probably somewhere between 6 and 10 million fuel cell vehicles. With the loss of the market from ethanol going in MTBE that problem's going to get exacerbated, so we'll have even more methanol available on the world market.

By 2020, if you do have 40 million fuel cell vehicles, and they're all running on methanol, now you're talking about requirement for over 17 billion gallons of methanol, which does exceed the current world production capacity which is somewhere around 13 billion gallons. So, at that point you'd be building new plants.

Next slide. Why methanol, why methanol for fuel cells. Known as wood alcohol, methanol is a very simple molecule, CH3OH. It has no sulfur; should be no carbon-to-carbon bonds. You can think of it as being a liquified form of natural gas. But it's liquid at room temperature and ambient pressure.

Now, while most methanol is made today from natural gas, it also can be made from a number of renewable feedstocks.

Next. This is just a list of some of the methanol fuel cell vehicles that are on the road right now as prototypes. Most major automakers have methanol fuel cell vehicle programs, as well as hydrogen, and in some cases, gasoline.

Next. Daimler Chrysler's NECAR5 has been proclaimed fit for practical use. One of the reasons it's fit for practical use is by running on methanol you get the same range or a comparable range as you do today with gasoline and internal combustion engine. It's clean, it's quiet, much more energy efficient than an ICE.

Next, please. The Jeep Commander 2 is

another Daimler Chrysler vehicle, running on methanol. Originally was to have run on a gasoline reformer. And it's twice as efficient as the comparable ICE.

Next. Let's turn to the fuel. California has an extensive past history with methanol in its M85 program. This is where methanol was used with a gasoline blend of 85 percent methanol, 15 percent gasoline. It was used, at one point, up to 20,000 methanol flexfuel vehicles. There were over 100 public and private M85 fueling stations that were operated in California over a period of ten years.

Today there is just a handful of those stations left, but we did learn a lot from this program.

Next. We learned that off-the-shelf materials are available for methanol fueled vehicles, as well as fueling stations. One of the things we also learned is that you really, when you're doing this kind of work you need the full support of the retail station operators. In many opportunities we didn't have their full support and that was one of the detriments to the program.

Another was because we were using

flexible fuel vehicles the operator of the car can simply go and fill up with gasoline. We found out that more and more they were doing that. So, flex fuel really hinders fuel use and infrastructure development if you're looking at building alternative fuels.

Next, please. What does a methanol station cost. If you need say a 10,000 gallon double wall storage tank, two hose dispenser, capability of fueling 20 vehicles per hour. If you're going to dig a hole in the ground and put an underground tank, it's somewhere around $62,000, if you're building one. Above-ground tank is 55.

You may be able to take an existing double-wall tank, which is the requirement in California, refurbish it and put some methanol compatible material in the liner and you're good to go for less than $20,000.

And there's also technology for an inner liner that can go inside an existing double-wall tank, and can be used for methanol.

Next slide, please. If you aggregate these infrastructure costs you assume $50,000 per station to again put in a 10,000 gallon tank, pump with two dispensers. To get 10 percent market penetration in California you're talking about $60 million; 25 percent, 146.

Now, if you're looking across the United States to get something like 25 percent market penetration, that should be about $2.3 billion. I think the "Big Dig," a tunnel in Boston, costs more than that. So you're really not talking about a big price tag when you look at it from a broader perspective.

To make reformulated gasoline I think the oil industry invested somewhere around $12 billion, and that, right now, is about a third of the gasoline pool.

So while the numbers may look big, when you put them in context they're really pretty reasonable.

Next, please. What are methanol production costs. The average wholesale price for methanol has been 46 cents. Methanol is a chemical commodity as well as a fuel. Its price rises and falls, largely tagged to the price of natural gas, which is our basic feedstock.

Last year methanol was selling at 60 cents; last week it was selling at 32 cents. So there is some variability on methanol. Although if you're looking at pricing methanol for a large fuel market, say a broad fuel cell vehicle market, the industry would be very happy to talk about kind of fuel pricing structures that would be tagged to something like the price of gasoline.

New methanol technologies going much bigger. Megamethanol plants, that should be 5000 metric tons a year. You're talking there these large scale plants, 1.6 or more million gallons per day production costs, fully recovered at 24 cents per gallon.

And these plants typically cost -- and they're being built today for about $450 million. Most of the new plants are being built in places where natural gas is cheap. Places like Trinidad, Chile, Equatorial Guinea off the coast of Africa where they're using flared natural gas to produce methanol, floating methanol production plants.

Next slide, please. What's the cost at the pump. If you take the price of methanol at a wholesale market at somewhere between 30 and 45 cents, you add all your distribution taxes, pump price 67 to 82 cents per gallon. When you put that on a gasoline equivalent gallon basis you're talking 77 to 94 cents per gallon. That makes methanol very competitive with gasoline for a vehicle market.

Next, please. What I want to do now is, I wouldn't say that there's a vast right wing conspiracy, but there has been an effort to kind of brand methanol with a negative image.

I want to look at some of the labels that have been placed on methanol. One is that methanol is highly toxic. Well, methanol is slightly more toxic than gasoline. It's fatal ingestion range is just a little bit lower than gasoline.

However, methanol is not carcinogenic and it's not a mutagenic product. Gasoline, however, can contain literally dozens of chemicals that are highly toxic and carcinogenic, to name benzene or toluene units, too.

Next, please. Leaks of methanol from underground storage tanks will poison water supplies. Methanol is not MTBE. Methanol is an alcohol fuel; MTBE is an ether. Methanol, like MTBE, is readily soluble in water, it mixes with water infinitely.

The difference here is that methanol is

readily biodegradable. It is not persistent in the environment. It is readily eaten by micro-organisms of both aerobic and anaerobic environments.

Next, please. As you see here the half life for methanol, the one I'd focus on is on the bottom, groundwater. Methanol's half life is one to seven days. Benzene half life is ten days to a bunch of years. So, again, methanol is readily biodegradable in the environment.

Next, please. In fact, it's so biodegradable that they inject it into wastewater treatment plants. About 100 plants in the country inject methanol. This is a picture of the Blue Plains Wastewater Treatment Plant outside the city where they're now injecting somewhere around six million gallons a year into the plant.

Why do they inject methanol? Because it accelerates the biodegradation of the wastewater, and it reduces nitrate loading that would be going into, in this case, the Chesapeake Bay.

Next, please. Gasoline is the best transition fuel to hydrogen, and methanol is the wrong track. Well, actually methanol, we feel, is an ideal hydrogen carrier. It's a liquid fuel.

It's consumer friendly. The transition from gasoline to methanol to the consumer at the pump will be invisible, transparent.

Methanol can be made from renewable refeed stocks. The next technology down the road, there was some discussion earlier about the cost and problem with reformers, the next technology is the direct methanol fuel cell.

A lot of companies are doing work on DMFC. You don't need a reformer. The fuel cell reacts directly with the liquid methanol. You're first going to see this probably within 18 to 24 months in things like cell phones running on direct methanol that will give you about a month standby time on one ounce of methanol.

So, the first fuel cell that you'll probably see and have in your home will be running on methanol.

And Daimler Chrysler and others feel that this technology will be mature for the vehicle market around 2008, 2010. And that's probably at the point where we're really ramping up to significant economies of scale production of fuel cell vehicles.

And, again, the infrastructure costs, we believe, are much lower than removing sulfur from gasoline for a fuel cell application.

Next, please. We can use flared natural gas to produce methanol. Using 10 percent of the world's flared national gas we could produce enough methanol to run close to 10 million fuel cell vehicles.

Floating methanol production plants can economically recover natural gas that otherwise is going to be left in the ground. This is natural gas that is largely unrecoverable, or it's hard to find a way to monetize these natural gas reserves.

You turn it into methanol in a floating plant; put it on a ship; and bring it right to the market. So now natural gas is not limited to being pipelined to its customer. You can take methanol and turn it into a liquid fuel and move it all over the world.

Next, please. Renewable feedstocks. Methanol can be made from wood, landfill methane gas, a number of other agricultural feedstocks, sewage. UC Riverside has a pilot scale facility using the Hynol process to convert sawdust to methanol.

There's a company called Alcohol

Solutions that's building a plant on top of a landfill in Ohio right now to make methanol that's then used at a wastewater treatment plant locally for denitrification.

Next, please. I believe gasoline is the wrong track. Gasoline in a fuel cell will always be less efficient and it will be dirtier. The clean gasoline that's required for fuel cell vehicle is not refined today.

And also, by focusing on the down-the-road promise that you may be able to reform gasoline, I think you're really putting off the introduction of hydrogen and the other fuel cell vehicle technologies.

Next slide. I think this one will get a groan from my hydrogen friends, but when consumers, we talked to consumers the first thing, the mental image they get with hydrogen, that's it. And if it's not the Hindenberg, they may get a mental image of a bomb.

I mean that's going to be a very difficult consumer perception to change. It's going to require a lot of time and effort. And it may never ever be overcome.

I don't know if anybody here has been to the California Fuels Partnership, I'm sure many of you have, the fueling facility they have for hydrogen takes up an enormous amount of space. It also, for hydrogen, requires significant setbacks for safety concerns.

A typical urban footprint of a gas station, a corner gas station, would make it very difficult to accommodate things like hydrogen storage tanks, compressors, steam methane reformer. And if you want to go another step further and put in a stationary fuel cell that costs $850,000, that's difficult to justify economically. And, again, the footprint of a typical gas station is not going to let you put in a stationary fuel cell that's the size of a trailer.

Next, please. Everybody's heard about Iceland, claimed to be the first country to adopt a hydrogen economy. They want to convert all their cars, buses and their entire fishing fleet to fuel cells.

Iceland's Doctor of Hydrogen has said that the way he wants to accomplish this is to produce methanol from renewable feedstocks. He believes this is the quickest path to fuel cells and hydrogen economy. Because developing a gaseous hydrogen infrastructure would be both time consuming and expensive.

They want to use electricity to produce the -- electricity from hydro power to produce methanol, or to produce methane from -- and take CO_2 from a steel plant, put them together and make methanol. So they want to have Iceland's hydrogen economy based on the use of methanol for their vehicles.

Next slide, please. Some of the efforts underway in looking at methanol as a fuel cell fuel. There's a methanol fuel cell alliance that includes fuel providers, methanol companies, Daimler Chrysler and XCELLSIS. They're working together to promote the use of methanol as a fuel cell fuel for vehicles.

We also have a methanol specification council which involves auto, oil and methanol industries. We expect to have a report out by the end of this year that will have a hazard assessment comparing the use of methanol and gasoline for vehicles. And the purpose of the specifical council, as the name would lead to assume, is that they want to come up with a standard specification for methanol's use for fuel cell vehicles.

Next slide, please. I just want to touch on a couple of quick recommendations. Federal legislation that will provide tax credits for alternative fuel vehicles, alternative fuels and a fueling infrastructure are important.

The House, in its energy bill, included elements of the Clear Act that was introduced in both the House and Senate, providing the incentives for the alternative fuel vehicles. But the House dropped the incentive for the alternative fuels and for the fueling infrastructure.

According to one analysis that means that you're going to get a lot less alternative fuel vehicles on the road. Those tax credits are all going to be used by the hybrid vehicles and not alternative fuels.

In the Senate we're hoping they'll resurrect the full Clean Act, including incentives for the vehicles, the fuels and the infrastructure.

We would encourage automakers to use CAFE credits for the sale of methanol fuel cell vehicles. A fuel cell vehicle operating on methanol will probably get a CAFE credit of somewhere around maybe as much as 175 miles. That is a real use of what the CAFE credit program was designed for, to stimulate dedicated alternative fuel vehicles that have significant range and environmental benefits.

We also support CARB's ZEV regulations, as well as the partial credits for methanol fuel cell vehicles operating reformer. And again, down the road, a direct methanol fuel cell will qualify, we believe, for full ZEV credits.

And the last slide, please. We also believe that there should be an emission trading mechanism set up to monetize the value of CO2 emission reductions that you'll get from fuel cell vehicles.

We encourage automakers to use aggressive marketing campaigns for fuel cell vehicles. We're thrilled to see a Honda ad recently that talks about a fuel cell vehicle at the end of their national campaign.

When we were working on the methanol M85 program, I don't think we ever saw any national campaigns from the automakers to advertise those flexible fuel vehicles.

In fact, today the ethanol flexfuel vehicles, the vehicles, themselves, don't even have a label on them that shows that it's capable of running on the alternative fuel. So I think we need some aggressive help from the automakers.

We'd like to see increased funding for direct methanol fuel cell research. A lot of this is basic research. A lot of it's been pioneered right here in California at the Jet Propulsion Lab at the University of Southern California. So that's kind of home-grown California work that will probably be the first place again that you'll see fuel cells commercialized, using the DNFC technology.

And then finally we support the demonstration of methanol fuel cell vehicles and the fueling station that's going to be built by the end of the year at the California Fuel Cell Partnership.

Thank you.

MR. WUEBBEN: Great, thanks very much, Greg. I'd like to now actually go to Jim Evans of Equilon, if I can, because I know you've come an awful long way, and I want to make sure you get an opportunity to provide, and then we'll go after that to our biodiesel.

Jim's with Equilon Enterprises, and going to talk about gas to liquids.

MR. EVANS: Actually Paul just stole my line because I was going to say the only thing standing between me and the audience and their refreshments was this presentation. So I think that now that one's gone, I'll have to find something else, and I'll insert it a little bit later.

MR. WUEBBEN: Keep you on your toes.

MR. EVANS: Equilon Enterprises, for those of you who may not be familiar with it, is the JV for Shell and Texaco today that will probably disappear very shortly with the Chevron purchase of Texaco. So there may be a name change that you'll have to get used to.

What are gas to liquids, and why would there be an incentive to look at a fuel that could be developed from gas to liquids?

First of all, you've heard a number of other presenters talk about the fact that there are natural gas supplies that are around the world, and a number of them are stranded. Meaning that they don't have the infrastructure in their particular location to support their use.

Some of that material is flared. There is a portion of the other material that is probably reinjected back into the well from whence it came, or the field from whence it came.

If you look at the total reserves, 140 thousand billion cubic meters. Now, someone's going to say, well, gee, Sean, convert that to quads for me. But I'll let him do that.

(Applause.)

MR. EVANS: The annual global consumption you can see is only about 2100. So when we start looking at what you could do with this type of energy source, the conversion of that natural gas to a liquid fuel becomes a very attractive option.

And we think that it enables the industry to take advantage of this abundant gas reserves that are currently accessible. And it also tends to complement some of the other end uses for the natural gas that's available, either as liquid natural gas or as feedstock to methanol plants, as you heard a little bit earlier.

Next slide, please. Now why do we call

it gas to liquids? In essence it is easier for us to talk about G to L than it is to pronounce the official reaction, fissitropes, every time we want to talk about it out in public. Because invariably fissi will be misspelled.

But what we do is we take the natural gas and do a partial oxidation to convert it to hydrogen and carbon monoxide. And then across, in this particular case, a proprietary fissitropes catalyst. We convert it to a feed that is available for hydrocracking and we take those hydrocracked materials to a distillate fuel, either kerosene or gas oil.

And you can see that the portion of it that is hydrocracked will come out as middle distillates. The preponderance of that currently for us is going to a gas/oil product in the range of diesel fuel.

And then there is some additional waxy materials that the particular plant that I'm referring to, and you'll see a little bit later, produces a significant amount of wax for the U.S. market.

Next slide. I have thrown in a couple of slides that show some of the emission benefits that could be associated with a G to L gas/oil fuel. This is the light duty system. You'll probably be able to see that the comparisons are being made against a European fuel.

But you can see reductions for light duty diesels that run the gamut across particulates, NOx, hydrocarbon and CO, as well as hydrocarbon plus NOx.

Next slide. For heavy duty emissions, and again, this is against a European fuel, you'll see that particulates, NOx, hydrocarbon and to a lesser extent, CO are all showing reductions with a gas to liquid fuel.

Next slide. As we start to look at what would be involved in bringing a fuel like this to the marketplace there are a number of things that immediately come to our consideration.

A part of it always has to be the whole question of driver perception. And in this case, with the gas/oil that is predominately paraffinic there is a reduced heat content, therefore there is a slight reduction in the energy that would be available for the driver in particular to notice.

There is also the question about elastomer compatibility for the fuel systems. And here in California we are intimately aware of what has happened with some other situations where we have seen a change in the -- of fuels that have affected elastomers.

Diversity with this type of fuel is a factor that would really come into play if you were not able to make a correction. Cold flow performance is something that affects all diesel engines, and would need to have a review.

But areas of sustainability and biodegradability, early studies have indicated that they're not only competitive with a standard diesel fuel, but in biodegradability, the biodegradability of a gas to liquid fuel is much better than we would expect.

And finally, for stability, the fuel, as a paraffinic based fuel is extremely stable, and does not succumb to the potential for sludge formation that you might see with some of the more historic diesel fuels.

Next slide. And some of the details that we look at in terms of elastomer compatibility, as an example, we probably want to insure that those vehicles that are using, and those fleets that are using this type of fuel had been appropriately designed for the fuel, itself.

Lubricity, we find that this material responds very well to current lubricity additives that are out in the market. And for cold flow, we see that there is a range of cold flow performance that we're able to achieve with our new catalyst at the facility.

And we would also note that in some cases you find that there is a tradeoff between cetane number and cold properties. With our new catalyst and the facility we are able to remove some of the problems associated with moving cold flow down and not losing our cetane values.

Next slide. The conclusions that we would bring is that from looking at that fuel is that there are significant emission benefits that may, indeed, result from the use of a gas to liquid fuel for both light and heavy duty equipment.

We are studying the well to wheels emissions and we expect to see that indeed it is going to be similar to crude derived diesel.

The problems that I had touched on in terms of lubricity, cold flow, stability are things that are all manageable.

And some of the aspects that we're looking at for our further consideration are the potential for blends of G to L, or gas to liquids, with conventional diesel and the use of 100 percent diesel.

But I think that what you will find is that in looking at a gas to liquids fuel it essentially becomes a drop-in replacement for diesel fuel, either as a 100 percent, or as a blend with normal diesel.

Next slide. We think that indeed it has already demonstrated that it's a suitable blending component. In fact, gas to liquid gas/oil has been used as a blending component for car diesel since approximately 1994.

It also offers, by virtue of some of the qualities, with those qualities being the fact that the cetane number is in the range of probably 75 to 85. The sulfur content is less than 2 ppm. The aromatic content is less than .5 percent.

We think that when you start looking at those kinds of properties, that it, indeed, becomes a very attractive material for a premium grade of diesel fuel.

And, once again, it is suitable as a

stand-alone or drop-in replacement for existing diesel and is applicable to current diesel engine technology that is on the road today.

Next slide. As we look at G to L, one of the things that we continue to do as part of our ongoing program is to try to evaluate emissions testing against the newer fleets of engines that are coming on. And those tests are in progress.

And what we are now in the process of doing is taking these initial production experiences and taking the product to market where we're looking at options in Europe and the U.S. And California, of course, is an obvious candidate for a portion of this fuel.

Next slide. So, where does the fuel come from? The current production for gas to liquid fuel for the Shell system is a plant in Bintulu, Malaysia. Immediately one can recognize that that was probably a stranded natural gas supply that made it an attractive location.

And the production for diesel fuel is approximately 3000 barrels per day. A relatively small number, but not an insignificant volume. But it is the intention that Shell has already announced to increase their G to L production. And we have a design for a 70,000 barrel per day plant of which the out-turn from that one, rather than being something on the order of the lower concentration that you see for the current Bintulu plant, this is going to be approximately 50 percent of the out-turn from that plant would be a G to L gas/oil or diesel fuel drop-in.

The other thing that you can notice there in the upper right-hand corner is that this is not a planned facility. We currently have a plant in operation, and has been operating since 1993.

Next slide. So then what are the marketing activities that would seem to come from a G to L. We're looking at transportation from Bintulu to the U.S. markets. We consider that there is an opportunity, and also a desire to both have an alternative diesel fuel with the properties associated with this particular fuel in the U.S. market.

And it also gives us an opportunity to begin some demonstration activities, in addition to a direct commercial marketing for the fuel.

Some of the things that we have to work

to overcome is the fact that when you look at 3000 barrels a day as an example for the total out-turn out of that facility, that is an extremely low volume as compared to other commercial fuels here in the U.S.

And by virtue of that, and the special qualities that are associated with the fuel, segregated handling is absolutely necessary to preserve those unique qualities because it wouldn't take much contamination from almost anything else that's in the current fuel diet to destroy some of those qualities.

And we have been able to show that there are some special application additives that have been required in some cases with probably the one that is the most significant is the development of a lubricity additive that essentially takes this material and gives it the lubricity that one would expect with a standard diesel fuel anyplace in the marketplace today.

I think that will cover some of the activities that we're looking at.

Next slide. It's actually a fairly large plant. And against that backdrop you may recall that the most recent announcement for a G to L plant here in the U.S. is a 70 barrel a day plant.

MR. WUEBBEN: Is that the end of your presentation? Great, appreciate that, Jim, that's really very informative.

Our last speaker, but certainly not least, is Graham Noyes with the World Energy Alternatives, to talk to us about biodiesel. So, welcome, Graham.

MR. NOYES: Thank you, Paul, and I'd like to congratulate everyone that made it. I will return to the mike, I promise. But my first slide, as it comes up here is what is biodiesel. I'm just taking a walk around the room so I can see how many people are still awake here. And pass out a few samples so you can, I think the smell and appearance of it is very interesting, and makes it a little more real than just hearing what it is.

The biodiesel I've given you there, and if you can pass those around, we don't recommend drinking them, but it is a substance less toxic than table salt, so it's not much of a problem if you do.

Biodiesel is made from a variety of

vegetable oils. The product you have there is distilled product made by Proctor and Gamble that's made from soybeans.

And essentially, if we go to the first slide there, you can also make it from mustard seed, safflower, corn, palm. You can also make it from waste oils including you'll hear sometimes about people burning McDonald's waste oil in their diesels. They're talking about biodiesel.

The process that's involved is essentially pulling the glycerine out of the oil, and what's left is a methyl ester that is very similar to diesel fuel in all of its properties.

As far as sort of the practical aspects of biodiesel, it's an extremely simple fuel to implement. It mixes with diesel fuel at any blend level, so you can put 2 percent blend level into a diesel fuel to improve the lubricity of diesel fuel.

You can run a 20 percent blend, what they call B-20; 20 percent biodiesel, 80 percent diesel, with no need for additives or special blending processes. Or you can run 100 percent biodiesel, what we call B-100. I actually run that in a Volkswagen Jedda that I have, a TDI

Jedda, run it pure all the time.

No modifications. No changes to infrastructure. It works within the existing diesel infrastructure and works in any diesel engine. So, when you say, well, where does biodiesel fit in, it fits in anywhere where there's a diesel engine. You can run it in a sailboat marine engine. You can run it in a small or a large generator. You can run it on ferries, and you can run it in any of the conventional heavy equipment diesel equipment that's out there.

Like ethanol, it's an oxygenate fuel. It's about 11 percent oxygen by weight. That actually improves the combustion process a little bit when you're working with a mix with diesel fuel.

If you're particularly on the higher blends you can actually smell sort of a popcorn smell when it's coming out the tailpipe. I do typically, when I'm demonstrating and talking with fleet managers, bring them out to the vehicle so they can smell when it comes out of the tailpipe. Not too many people want to stand behind a diesel. This is a nice change there.

We'll get into specific emissions

performance. One of the other benefits of biodiesel, because it's a vegetable oil base, it's a very safe fuel to work with.

It's flash point is over 300 degrees. It's completely biodegradable. We actually ship it around via UPS because it's a nonhazardous substance to work with. And deliver five-gallon pails all around the country like that. It's something where if you spill you have a mess, but that's about it.

It's cetane number is similar to carb diesel or a little higher. It's lubricity is better than the diesel fuel that's out there today, even at a 1 or 2 percent blend, it provides tremendous improvements in what you see from engine wear.

Next slide, please. We've talked about all these issues. I don't need to hammer them. As you can see we fit into all the categories where we want to be. We grow all these vegetables here in the United States.

We'll go through the pollutants specifically, but a key thing to note, the Department of Energy did a full life cycle analysis with biodiesel from raising the soy beans till they were burned, out the tailpipe, and found a 78 percent reduction in carbon dioxide emissions.

We'll see, also, because we're dealing with vegetable instead of petroleum, tremendous improvements in terms of particulates, and in terms of the nature of particulates that are coming out of the tailpipe.

Obviously we've got a new market for U.S. farmers; and we actually are not sacrificing any performance in terms of the diesel engines. We can keep using those diesels.

Next slide, please. Some of these things we've touched on already. This is -- biodiesel is something that you can do tomorrow. You can implement it into a fleet as quickly as you want to.

I got a call from the Post Office this summer on a Thursday, San Francisco U.S. Post Office, saying they wanted to start a diesel program, a biodiesel, a B-20 program, biodiesel/ diesel mix. I got that call on Thursday. On Monday they were running B-20 and they've never stopped since. They're very happy with it.

Several fleets have implemented programs without telling their mechanics and their drivers. And the mechanics and the drivers have never known it.

Because you can bring it in quickly, you can also move out of it quickly. You use the diesel storage tanks. You use the diesel pumps. You use the diesel delivery vehicles.

So we have what sometimes we've referred to as a bridge fuel, where as some of these encouraging technologies are coming on line, whether they're five, ten, 15 years out, here's something to improve things immediately in the interim.

Biodiesel made from the soy product that's around today and what's typically made in the United States has, at most, trace levels of sulfur in it. It's less than 1 ppm sulfur. So it works with all the after-treatments that are out there. And completely eliminates sulfur dioxide emissions if you're talking about the B-100.

And you can see a very high 3.2 to 1 energy value there, better than any other fuel that's out there.

Next slide, please. That's a breakdown. And I do have lots of materials out front. I don't need to read numbers to you. One thing that is crucial to recognize in terms of NOx is biodiesel does not, by itself, deliver improvements on NOx.

So we see on the B-20, which is what most fleets use, a slight increase there. This is from the federal EPA testing. These tend to be the higher numbers that we've seen on NOx. But it's the most solid testing out there, so it's what we want to stick with across the board.

NOx is obviously a key issue here, and it's what's slowed biodiesel down in California, is the focus on NOx. But there are compelling reasons to look at the big picture with biodiesel, particularly if you're trying to get renewables into the picture.

And there are NOx reduction strategies that are available with biodiesel, including the catalysts, all of which will work with biodiesel. Engine retard, which can bring that NOx down below. And then we're working with some additives, and we're working on some emulsification techniques to try and bring those NOx numbers down.

Next slide, please. Everyone's familiar

with some of the warning signs about diesel exhaust that are out there. And the familiar look of the haze coming out of school buses, something that we're all concerned about.

Next slide. This is the Lovelace Respiratory Institute. They did the Tier 2 testing for the EPA. And essentially that testing is to establish the toxicity of the fuel.

This is B-100 testing. They couldn't find any toxicity with the fuel. They actually had to go back to the EPA and ask to deviate from the protocol because as much as they spewed in there they didn't -- they weren't producing any toxicity with the subjects they were working with there. So we saw very positive signs across the board there.

Next slide. I broke out the PAH emissions. These look like gibberish. Are those at all readable? Those are probably more readable on your slides. You can get the gist of it just from the fact that the top bar there on all those PAH emissions is number 2 diesel; and the lower more purple line is biodiesel. You can see profound reductions there across the board in the PAH emissions.

Next slide. And then even more profound emissions reductions on the nPAH. So some of the things we're most concerned about in terms of diesel particulates, biodiesel lends great help to.

Next slide. Some of the fleets using, this is not something that is just in the testing stage, this is something that's all over the country.

I mentioned the Post Office. We also brought Oakland on line recently. U.S. Military went out to bid; about 25 bases nationwide are going to be using biodiesel. Department of Energy is instituting biodiesel in many of its sites nationwide.

We have utilities all over the country using it. Transits, Departments of Transportation, tremendous interest in biodiesel at the last Clean Cities meeting; it was identified as the fastest growing alternative fuel.

Next slide. Costs. Costs are always key. We talked about some of the different ways to use biodiesel. If you're talking about the super low blend, the B-2, you're adding about a penny a gallon.

There's no tax incentive for biodiesel, there's no tax credit, there's no subsidy provided. We're competing head to head with petroleum here, but we did receive a commodities credit subsidy that has helped this year. But nonetheless we are pushing costs as well as we can, a very small industry breaking into a big one.

B-20, 12 to 14 cents a gallon; and pure biodiesel at 50 cents a gallon. No additional costs in terms of vehicles or infrastructure.

Next slide. And then I did a break out here. If you're looking for petroleum displacement, just a couple of hypotheticals. In terms of how you can achieve petroleum displacement and what it would cost.

And I used 40 gallons a day, which with most of the fleets I work with is fairly normal. Obviously fleet vehicles are all over the board depending how they're used. But this is something you can use on the old side of the fleet, on the dirty side of the fleet, and you can implement immediately.

You can see you can displace the -- that one vehicle there, at a cost of $5000 a year. You've eliminated petroleum usage; you've taken one full vehicle off the road.

Or you can go with a B-2 type approach, using 50 vehicles, you're looking there at a $5000 cost to displace 10,000 gallons of petroleum usage with an American grown product.

Next slide. This is probably better represented in the materials that are handed out. You'll see the triangles and the things didn't quite line up there. And no matter how I tried I couldn't get Powerpoint to line them up for me.

But, we have the existing biodiesel plants out there. Most of them are in the midwest. And then we have suppliers. Oleo Chemical Plants, I mentioned Proctor and Gamble. The reason Proctor and Gamble makes biodiesel is that they don't really make biodiesel, they make glycerine. They're not interested in the biodiesel, that's the end product of their process.

So we have a tremendous amount of oleo chemical capacity that's out there and ready to tap into.

And then there are planned expansions.

Many people have been very impressed by the opportunities biodiesel presents.

Next slide. And then going through, and I'm just going to get through these slides real quickly here. Estimates in terms of what biodiesel can do to reduce petroleum usage based on existing plants, based on in 2002 bringing those oleo chemical plants on line. And then continuing the growth curve.

Next slide. The people always ask, well, how much feedstock is out there. Far more feedstock is out there than we're currently utilizing, or that we're going to be pushing in any short-term period.

You can see the virgin oils there, the waste oils. And then after we get past the ten-year period, an opportunity to bring algae on line. Algae is another source for oils that the Department of Energy has done a lot of work with.

Right now the costs are too high for it to be feasible, but as the petroleum stocks start to dwindle, those are going to become interesting again. And there may be some ways to raise the algae that we're able to find in that time period.

Next slide. And that's the potential

assuming the good figures. We have a tremendous potential based on assuming petroleum usage to be even, which obviously we don't know where it's going to be in 20 years.

Next slide. Finally, the strategies to help biodiesel growth here in California. A couple of states have taken very aggressive approaches already. Texas has established a program whereby the biodiesel portion of the blend is not taxed. So if you've got a B-20 none of the biodiesel is taxed. That's a tremendous help in terms of reducing the costs.

Hawaii has a program now where if you have at least a 20 percent blend, the overall tax rate on the blend is reduced 50 percent. That's even more of a boost.

Integration into CARB and AQMD programs, there are a lot of fleets that would very much like to use biodiesel. Many fleets that have their diesel vehicles, love their diesel vehicles, don't want to give up their diesel vehicles, and particularly in situations where they're getting exemptions from AQMD programs, they could use biodiesel in those vehicles, increase renewable usage, decrease particulates and toxins, and achieve the goals that this workshop is focusing on.

An EPAC type program is another option for California. I think any EPAC program that was started today ought to have a actual fuel usage component, which EPAC lacked.

Any kind of offset, funding obviously would be good. We don't have any right now out there. And that's been holding us back. But we're still growing fast.

And research and development of some of these other feedstocks.

Because biodiesel is something that goes now and goes in diesel vehicles, it is a fuel that ought to be implemented now. Whether it's going to be in the picture in a big way in ten years is very uncertain. But to achieve reductions in particulates, and petroleum displacement, there's nothing to beat it for this year.

Thanks very much.

MR. WUEBBEN: Great. Graham, thanks very much.

(Applause.)

MR. WUEBBEN: Well, with some caution at the hour I want to ask the audience if they may have any questions. And, Sergio, you've come from New York, you certainly can ask questions.

DR. TRINDADE: My name is Sergio Trindade, a New York based consultant interested in ethanol. I have a question -- a comment, and then two questions.

This workshop is about energy dependence, and I don't think we have quite discussed the meaning of dependence to the extent that we have a common baseline to talk about.

This leads me to a comment on the essence of the concern here is that the United States has access to fuels, even, you know, if it is in its own territory or perhaps in areas in which it is integrated commercially, such as NAFTA and perhaps in the future the so-called FTAA, the Free Trade Area of the Americas, which is under negotiation now, and covers the whole of the western hemisphere.

That is important because it would open up supplies of renewable fuels that are, at this point, perhaps less accessible.

So, two questions. One for Neil Koehler, which is in connection with the survey by CEC. The question is whether that incremental capacity has a cost of production associated with it. In other words, it's pretty easy to build capacity, but at what cost.

And then there is a second question for Graham Noyes, and I'll just make them all at once just to -- benefit of time.

The 78 percent CO_2 reduction on the biodiesel as methyl ester vegetable oils. Is there any experience with ethyl esters of vegetable oils which could bring in renewable ethanol, and therefore increase the CO_2 benefits?

So that will be the two questions, thank you.

MR. KOEHLER: The first question, while the CEC didn't specifically address the cost of production, it's very clear that the new plants that are being built are, you know, state of the art. And so the variable costs are at least competitive, if not cheaper than existing plants.

But most of the plants that are in that survey and represent the doubling of capacity over the next few years are, you know, all corn to ethanol plants with some exceptions. There are a couple cellulose to ethanol plants in there.

So, you know, the real variable would be the cost of the corn, which is close to half of the cost. But generally those are all going to be very cost competitive if not the lowest cost production on line.

MR. NOYES: In terms of the life cycle analysis that was really kind of a somewhat worst case scenario, in that it was actual soy, virgin soy biodiesel that was used.

So where you actually would realize some gains if you were dealing with an ethyl as opposed to a methyl ester, you'd also realize some more gains if you were dealing with a waste product rather than a virgin product with the outlays involved in the farming of the virgin product. Even with that, we saw that 78 percent reduction.

One thing I skipped through my last slide and I wanted to mention to everyone, that the Department of Energy and CEC are sponsoring a renewable diesel workshop that's on September 25th, and is in the back of the materials if anybody wants a more intensive look into biodiesel and some of the other renewable diesel fuels.

DR. TRINDADE: But have you experimented with ethyl esters?

MR. NOYES: Well, no one has undertaken

anything like the level of study involved in the Department of Energy/Department of Agriculture life cycle analysis. So, it's obvious that we could realize some gains there.

And within the text of that report it makes reference to that. But in terms of quantifying that it hasn't been done.

DR. TRINDADE: Thank you.

MR. ADDY: Paul, I've got a question.

MR. WUEBBEN: Yes, please.

MR. ADDY: Thank you. My question is going to the use of natural gas as an emerging transportation fuel. Perhaps Sean and Jim might take these questions.

My name is McKinley Addy; I'm with the California Energy Commission.

It's been represented that as more stringent emission standards are implemented that the heavy duty natural gas vehicles would have in diminishing emissions advantage over competing diesel vehicles.

The implication being made that natural gas vehicles will be a less attractive fuel in the marketplace under those conditions.

But this indicates that as heavy duty

natural gas vehicles become, will become more competitive on an operating cost and perhaps a life cycle cost basis, as diesel vehicles become more expensive to operate due to more expensive emission control strategies that will have to implement it, as well as potentially a higher fuel cost. Sean?

MR. TURNER: Let me try to hop right in here. You've got a couple issues and I'll try to get all of them. If not, prompt me and I'll get to the other parts of the question.

The first is that yes, we have, I think there are some major assumptions being made in how, I mean I think it's pretty clear that as the diesel emissions come down and our emissions come down, that there's clearly a diminishing benefit.

But we made some -- I think we're making some significant assumptions that we're going to get down to 2007 levels, and that there's not going to still be a difference between natural gas.

So I think we're still struggling with vehicles getting to 2002 levels, much less 2007. And we're making an assumption that we're already there. I mean that's the kind of a common, you know, discussion point.

You know, there's a huge assumption underlying that. I think that's one issue.

The other is that -- help me again on what you wanted to hit on the increasing cost of diesel.

MR. ADDY: Yes, well, the second point was that natural gas vehicles, heavy duty natural gas vehicles are likely to maintain their competitiveness as diesel vehicles implement some emission strategies that become a little more costly, and that diesel, as a fuel, itself, will be potentially cost --

MR. TURNER: Yeah, I don't think there's any question. I don't know that anyone's arguing that the cost of diesel is going to go up. The cost of maintaining new diesel engines is going to go up. The added, the incremental equipment that has to go on vehicles to meet these new standards, the cost is going to be going up for those.

Yes, you know, if we make the assumption that we're going to meet a 2007 standard of .2 NOx and .01 PM, the difference between the two in total emissions is going to be quite small. But, but -- hang on -- go ahead.

MR. WUEBBEN: We probably need to move to a few more questions if we can. We've only got five or six more minutes here.

SPEAKER: Paul, I've just got a question about --

MR. TURNER: But there is several huge benefits here, and one of the reasons we're actually having the workshop today, is that even as we get down to those levels, we're going to have a humongous difference in the energy dependency issue we're here talking about.

We're using the natural gas from domestic resources, and there is an inherent value to doing that that is difficult to monetize. But there's a big difference.

MR. ADDY: Well, just one question -- Jim Evans, are there any hard estimates for natural gas use as G to L feedstock in the 2010, 2020 timeframe for the California market?

MR. EVANS: I don't know that you'd be able to look at an estimate specifically for the California market. I think that what we are doing is bringing forth a product that is coming from an existing plant that could be available as a direct drop-in.

We have announced plans to build approximately four more world class units that would take advantage of some of the stranded fuel. But the thing that we all have to be aware of is that while the California market is a specific market today, by the time a lot of these technologies that are being talked about across the table will come into existence, there will be a great deal of competition for those kinds of fuels.

In particular you can start to look to Europe and also to the northeastern states. And so don't think of it as kind of an isolated spot that all of the alternative fuels would tend to be headed to, McKinley. I think that by the time we approach 2004, 2007 kind of range, competition will be there for others to look at the fuel.

But, no, I don't know how much natural gas would be consumed. I'll be glad to get the number for you.

MR. WUEBBEN: I've actually got a supply question I'd like to pose to Sean and to Charles, perhaps. We've heard that 60 percent of the U.S. natural gas supplies are actually produced from wells that are less than four years old.

We've heard that the rig count for gas production is at an all-time high. That the decline rates on those wells are actually much higher than they've been in the last 20 years.

In light of that, and in light of the 7.1 bcf a day pipeline capacity coming into California is basically fully subscribed, and here we're doing everything we can to add the near-term market and opportunities through incentives, what do you see happening in terms of the near-term to address some of these as potential supply bottlenecks.

I think we've already seen Topock's LNG supply actually curtailed, the gas supply to provide that LNG, curtailed because of the incentives that were represented by the $60 a million Btu price back in December.

So, is there any confidence that you can provide us relative to steps that are being taken to try to insure very, you know, significant kind of a capacity augmentation beyond what we have today?

MR. TURNER: I'll try to hit the gas well issue as well as I can, and I have to admit that that's not very well.

But, I -- and you hit the LNG -- have to admit, Paul and I talked about this a few weeks ago, and I have not been able to get answers on the decline rate issue.

The only thing I can tell you from my own research so far is that, and it really leads back to what happened last year with the, you know, supply price spike. That we had the better part of a decade of very stable, very flat usage of natural gas in the U.S.

You know, mild winters, mild summers, and so the production, incremental production did not increase over that period. And then all of a sudden we tried to build a whole bunch of new electric plants, had some other issues with weather, and all of a sudden we feel like we're being choked.

And so it is going to take time, and I think we're already seeing it happen now for those production rates to go back up on the well side.

And, again, I wish I could answer the question better than that, but I think we've already seen that happen this year.

Just looking back at what happened to the prices, what happened on the supply side, you know, as of this past week I looked at the numbers on Friday, we're back down into the low $2 range, it's $2-and -- I can't remember, I looked at it on Friday afternoon, $2.19 per million Btu, something like that. Down from some $15.

So there's a huge fluctuation there, and I think a lot of that had to do with there were some constraints on supply. And there are, there are going to be. And the market is able to bear higher prices. People are willing, you know, the people, especially here in California, have made it clear to the marketers, and I think we've talked about this plenty here in the Capitol, that if they were willing to pay higher prices, and you know, competition broke out, and you saw some games going on in the marketplace.

But, I think even the latest report the CEC put out says, you know, there is interstate pipeline capacity being built now to cover our supply issues. And probably the biggest issue going forward is going to be the intrastate pipeline infrastructure in California to move that interstate gas throughout California. But that with, you know, the appropriate controls, and their report goes into this, with the appropriate controls and making sure we're doing the right thing along the way, we can work through those issues without any humongous effects on price or supply.

I mean, again, that's -- it's all prediction and it's all 20, you know, we're all looking 20 years out kind of numbers. But, I think that report went into it pretty clearly that, you know, the biggest issue we have is the intrastate pipeline issues. And that we're working on them, and we simply have to work on them, just to meet our electricity demand issues.

And as those happen, you know, the side benefit is that we have access to that additional capacity.

Again, you know, we're using this much capacity over the total system. And so what I was trying to prove and prove to myself and in my presentation is that we have a lot of gas available. And the portion that we're going to take off, even if we have a large penetration of vehicles into the marketplace, does not affect the overall supply or pricing in the gas industry.

MR. WUEBBEN: Okay, Charles, a quick summary.

MR. POWARS: Yeah, two quick points. One is that one of my charts showed the LNG capacity that's being added here in the state, and you might notice that most of that does not use pipeline gas. Especially one thing that looks attractive, and yet to be proven out for sure about LNG is that it makes economic sense in very small scale, which lends itself to landfill gas and flared gas. And that will be proven.

The second point is that even in larger capacity LNG production and storage and use is inherently levelizing, so it really takes much better advantage, of course, of pipeline capacity. And that's why we're trying to get things like large gas utilities interested in integrating liquefaction capability with new power plants. So that they can have an interruptible gas supply so that core users that really need the gas at peak demand times can have it, and they can operate.

MR. WUEBBEN: Great. Well, on behalf of the panel I really want to thank the audience first for sticking it out. It's the first workshop to compete with maybe the Grove Symposium to keep Dr. Lloyd here until nearly 6:00 p.m.

But I want to thank our panel, also.

They've done a great job. Thanks for the effort, gentlemen.

(Applause.)

MR. FONG: We will be starting tomorrow's session at 8:30. And any of you who need audio/visual assistance, we'll be here at 8:00, so bring your materials.

(Whereupon, at 5:43 p.m., the workshop was adjourned, to reconvene at 8:30 a.m., Tuesday, September 18, 2001, at this same location.)

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CERTIFICATE OF REPORTER

I, VALORIE PHILLIPS, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 25th day of September, 2001.

VALORIE PHILLIPS